

From: Howard, Leslie A CTR NAVFAC HQ, BRAC PMO [leslie.howard@navy.mil]
Sent: Tuesday, December 12, 2017 2:34 PM
To: Stoick, Paul T CIV NAVFAC SW [paul.stoick@navy.mil]
Subject: FW: [Non-DoD Source] RE: HPNS Parcel C Phase II Radiological Construction Summary Report RASO Comments
Attachments: Internal Draft Parcel C Phase II RCSR_11-6-17 (RASO Comments)_sm_sra_sm.docx; RE: N6247310D0809\0012\3EG29\ \NAVCON\51212530\N62473\RO6B2\Submitted

Follow Up Flag: Follow up
Flag Status: Completed

Paul,

My last correspondence with Shanti regarding CTO 0012. Matt Liscio approved their responses to his comments.

Also attached is an email from Danielle stating the CSR is internal only.

Thanks
Leslie

****PLEASE NOTE THERE IS A POTENTIAL FOR SIGNIFICANT DELAY IN RECEIPT OF YOUR EMAIL, PLEASE CALL IF A QUICK REPLY IS NEEDED****

Leslie A. Howard, CHMM
Environmental Engineering Support II
Navy BRAC PMO West
33000 Nixie Way
Bldg 50, 2nd Floor
San Diego CA 92147
Desk Phone: 619-524-5903
Main Office Phone: 619-524-5096

-----Original Message-----

From: Montgomery, Shanti [mailto:Shanti.Montgomery@tetrattech.com]
Sent: Thursday, November 30, 2017 7:04 AM
To: Howard, Leslie A CTR NAVFAC HQ, BRAC PMO
Cc: Janda, Danielle L CIV
Subject: [Non-DoD Source] RE: HPNS Parcel C Phase II Radiological Construction Summary Report RASO Comments

Good morning Leslie,

Please see attached response to Matt Liscio's comments on the Phase II CSR. In response to his

comment regarding App H, please see below:

The value of 16.13 ($\mu\text{rem/h}/\mu\text{Ci}$) is correct. It is the dose rate per unit activity for Ra-226 (plus all of its decay products) at one foot from a point source. It was calculated by converting the dose rates provided in units of ($\text{Sv/h}/\text{MBq}$) in Table 6.2.2 of the Radiological Health Handbook but the original source is Unger, L. M. and D. K. Trubey, 1981. Specific Gamma-Ray Dose Constants for Nuclides Important to Dosimetry and Radiological Assessment, ORNL/RSIC-45; Oak Ridge National Laboratory, Oak Ridge, TN which is cited in the references of Appendix H. The definition of a point source when measuring the dose rate at a foot is any source whose maximum dimension (height, width, or length) is less than or equal to 3-inches. The constant, 16.13 ($\mu\text{rem/h}/\mu\text{Ci}$), is the dose rate at a foot distance from an ideal point source of Ra-226 (along with its 12 decay products all of which are assumed to be in secular equilibrium e.g. at the same concentration as the Ra-226).

Please let me know if there are additional questions or clarifications required.

Thanks!

Shanti

* Think Green - Not every email needs to be printed.

-----Original Message-----

From: Howard, Leslie A CTR NAVFAC HQ, BRAC PMO [mailto:leslie.howard@navy.mil]

Sent: Tuesday, November 28, 2017 2:30 PM

To: Montgomery, Shanti <Shanti.Montgomery@tetrattech.com>

Cc: Danielle Janda <danielle.janda@navy.mil>

Subject: HPNS Parcel C Phase II Radiological Construction Summary Report RASO Comments

Hello Shanti,

Please see attached comments from Matt Liscio on the Phase II CSR. In addition, he had this comment below regarding the attached page in App H:

The attached is a page out of Appendix H (Pg. 402 of the PDF from the CD). It looks like the specific gamma ray constant used was 16.13 $\mu\text{rem sqft} / \mu\text{Ci hr}$. For Ra-226 alone the value typically used is $1.21\text{E-}2$ $\mu\text{rem sqft} / \mu\text{Ci hr}$. I've seen various values for Ra-226 plus progeny in equilibrium but they're typically around 8 or 9 $\mu\text{rem sqft} / \mu\text{Ci hr}$. It's hard to tell what assumptions were made to determine the value used for this constant in this report.

Thank you
Leslie

Leslie A. Howard, CHMM
Environmental Engineering Support II
Navy BRAC PMO West
33000 Nixie Way
Bldg 50, 2nd Floor
San Diego CA 92147
Desk Phone: 619-524-5903
Main Office Phone: 619-524-5096

From: [Janda, Danielle L CIV](#)
To: [Howard, Leslie A CTR NAVFAC HQ, BRAC PMO](#)
Subject: RE: N6247310D0809\0012\3EG29\ \NAVCON\ \51212530\N62473\RO6B2\Submitted
Date: Tuesday, October 10, 2017 2:35:41 PM

The construction summary report is internal so it doesn't hurt to have them send it. We also need to make sure they submit their data to NIRIS.

V/r,
Danielle Janda
(619)524-6041

-----Original Message-----

From: Howard, Leslie A CTR NAVFAC HQ, BRAC PMO
Sent: Tuesday, October 10, 2017 12:12 PM
To: Janda, Danielle L CIV
Subject: FW: N6247310D0809\0012\3EG29\ \NAVCON\ \51212530\N62473\RO6B2\Submitted

Hello

Question about CTO 0012 with TtEC... The only outstanding task is the Construction Summary Report, which was due September 26.

I was going to contact Shanti to see where they were with submitting this document, but thought I'd better check with you first.

Their latest invoice is attached (includes costs for latest submittal of the SUPRs).

Thanks

Leslie

Leslie A. Howard, CHMM
Environmental Engineering Support II
Navy BRAC PMO West
33000 Nixie Way
Bldg 50, 2nd Floor
San Diego CA 92147
Desk Phone: 619-524-5903
Main Office Phone: 619-524-5096

-----Original Message-----

From: Yantos, Christopher N CIV NAVFAC SW, BRAC
Sent: Thursday, September 28, 2017 3:34 PM
To: Howard, Leslie A CTR NAVFAC HQ, BRAC PMO
Cc: Casson, James G CIV NAVFAC SW, SDAS
Subject: FW: N6247310D0809\0012\3EG29\ \NAVCON\ \51212530\N62473\RO6B2\Submitted

This is a Hunters Point project, maybe Leslie's??

Chris Yantos
Remedial Project Manager
619-524-6023

Navy BRAC PMO West
33000 Nixie Way
Bldg 50
San Diego CA 92147

-----Original Message-----

From: Casson, James G CIV NAVFAC SW, SDAS
Sent: Thursday, September 21, 2017 11:47 AM
To: Yantos, Christopher N CIV NAVFAC SW, BRAC
Subject: FW: N6247310D0809\0012\3EG29\ \NAVCON\ \51212530\N62473\RO6B2\Submitted

The invoice # 51212530 for contract # N62473-10-D-0809 DO # 0012 is still in "Submitted" status since 08/28/17.

James Casson

-----Original Message-----

From: disa.ogden.eis.mbx.wawfnoreply@mail.mil [<mailto:disa.ogden.eis.mbx.wawfnoreply@mail.mil>]
Sent: Monday, August 28, 2017 1:17 PM
To: Casson, James G CIV NAVFAC SW, SDAS
Subject: N6247310D0809\0012\3EG29\ \NAVCON\ \51212530\N62473\RO6B2\Submitted

Action DoDAAC\Ext: N62473\RO6B2

Document Type: Navy Construction / Facilities Management Invoice

Status: Submitted

Acceptance Date:

Processed Date: 2017/08/28

Contract Number: N6247310D0809

Delivery Order Number: 0012

Contract Issue Date: 2012/07/10

Vendor CAGE\Ext: 3EG29

Shipment Number:

Shipment Date:

Invoice Number: 51212530

Invoice Date: 2017/08/28

Has been Submitted by Mathew Ghering on 2017/08/28. Status is Submitted.

The document is ready for your action.

Access the site at Wide Area Workflow e-Business Suite

Thank you for your prompt attention.

INFO: The following attachments are present on this document: 40440012_MPR_2017_08_Rev_0_51212530.pdf

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Base Realignment and Closure
Program Management Office West
1455 Frazee Road, Suite 900
San Diego, California 92108-4310

CONTRACT NO. N62473-10-D-0809
CTO No. 0012

INTERNAL DRAFT
RADIOLOGICAL CONSTRUCTION SUMMARY
REPORT
November 2017

PARCEL C PHASE II PROJECT AREA
HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA

DCN: RMAC-0809-0012-00XX



TETRA TECH EC, INC.
1230 Columbia Street, Suite 750
San Diego, California 92101-8536

Shanti Montgomery
TtEC Project Manager

Date

Steve Adams, CHP
TtEC Radiation Safety Officer

Date

EXECUTIVE SUMMARY

The U.S. Department of the Navy (DON) directed Tetra Tech EC, Inc. (TtEC) to prepare this Radiological Construction Summary Report (RCSR) to describe and summarize the Parcel C Phase II project area Ship Berths 1, 2, 3, 4, and 5 Final Status Survey (FSS) activities, and storm drain and sanitary sewer time-critical removal action at Hunters Point Naval Shipyard (HPNS) located in San Francisco, California. The Parcel C Phase II project area radiological removal action was performed to protect the public health and welfare, and the environment from actual or potential releases of radiologic contaminants. Except in relation to reuse as potential backfill material or waste characterization for disposal of excavated soil generated during removal of the Parcel C Phase II project area storm drain and sanitary sewer systems, this RCSR did not address chemical contamination and did not include or affect any other designated HPNS parcels.

Parcel C is located on the east side of HPNS and includes approximately 73 acres of shoreline and lowlands. The Parcel C Phase II project area is limited to Ship Berths 1, 2, 3, 4, and 5 and selected storm drain and sanitary sewer systems within Work Areas 31, 33, 34, and 35. Not all of the storm drain and sanitary sewer systems were addressed under the first or second phases of the Parcel C time-critical removal action. The remainder of the Parcel C storm drain and sanitary sewer systems will be addressed by the DON during future Parcel C removal actions. In addition, this RCSR does not include radiologically impacted Building 205 and associated discharge channel, Buildings 211, 224, or 253. These structures likely will be addressed during future Parcel C radiological work activities.

The Parcel C Phase II project area time-critical removal action was performed in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986 and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The radiological work completed in the Parcel C Phase II project area was performed under TtEC's United States Nuclear Regulatory Commission Service Provider Radioactive Material License.

Based on the radiological operational history described in the final "Historical Radiological Assessment, Volume II" (HRA) prepared by the Naval Sea Systems Command (NAVSEA) in 2004 (NAVSEA 2004) and site-specific investigative data, the DON determined that potential low-level radioactive contamination in soils and debris at HPNS required a response action. This decision was documented in the final "Base-wide Radiological Removal Action, Action Memorandum" (AM) (DON 2006).

The “Final Parcel C Record of Decision” (ROD) (DON 2010) was prepared to present the selected remedies to remediate soil, groundwater, and radiologically impacted structures. The ROD was developed and the remedies selected in accordance with CERCLA as amended by SARA and, to the extent practicable, the NCP. Remedial action objectives (RAOs) for Parcel C were established based on regulatory requirements, standards, and guidance; contaminated media; chemicals of concern; potential receptors and exposure scenarios; and, human health and ecological risks. The success of the remedial actions ultimately was measured by meeting the RAOs. As identified in the ROD (DON 2010), the radiological RAO for Parcel C was to prevent or minimize exposure to radionuclides of concern (ROC) in concentrations that exceed remediation goals for all potentially complete exposure pathways.

The objective of the Parcel C Phase II project area removal action described in this RCSR was to:

- Protect the public health and welfare, and the environment from actual or potential releases of radiological contaminants
- Prevent exposure to residual ROC in concentrations that exceed the release criteria and remediation goals for the ingestion or inhalation exposure pathways
- Achieve radiological release for unrestricted use of Ship Berths 1, 2, 3, 4, and 5 and selected storm drain and sanitary sewer lines in Work Areas 31, 33, 34, and 35

This objective was achieved by meeting the following radiological release criteria.

- For HPNS, the release criteria identified in the AM (DON 2006) and the radiological RAO established in the Parcel C ROD (DON 2010).
- For the storm drain and sanitary sewer systems removal action, the release criteria documented in Survey Unit Project Reports (SUPRs) prepared for each trench survey unit and presented in the SUPR Abstract (TtEC 2013).
- For those trench survey units containing elevated concentrations of naturally occurring radionuclides, the release criteria specified in the “Final Survey Unit Project Reports Abstract for Parcel C Sanitary sewer and Storm Drain Removal Containing Naturally Occurring Radioactive Material (NORM) Fill Material conducted after March 1, 2013” (NORM Abstract) (TtEC 2017).

The Parcel C Phase II project area was divided into four work areas (Work Areas 31, 33, 34, and 35) to expedite the storm drain and sanitary sewer removal action schedule and tracking activities. In addition, the Parcel C Phase II project area incorporates Ship Berths 1, 2, 3, 4, and 5. The Ship Berths were identified in Volume II of the HRA (NAVSEA 2004) as radiologically impacted. Ship Berths 1, 2, 3, 4, and 5 are located in Work Areas 31 and 34.

Chemical contamination at HPNS is addressed through the Installation Restoration (IR) Program process and is consistent with CERCLA as amended by SARA, and the NCP, to the extent

practicable. Eight IR Program sites are associated with the Parcel C Phase II project area. Samples of excavated soil derived from IR Program sites were collected and sent to the off-site laboratory for chemical analysis to verify whether the excavated materials met the reuse criteria. The chemical analytical results were compared with the applicable release criteria. Based on this comparison, soils that did not meet the appropriate criteria were stockpiled for collection and off-site disposal by the DON non-low-level radioactive waste (non-LLRW) contractor, along with non-IR Program site soils that exhibited odor or staining.

Storm Drain and Sanitary Sewer Systems

The present-day configuration of the storm drain and sanitary sewer systems at HPNS is the result of an evolutionary process. These systems were originally designed and built in the 1940s as a combined system, using the same conveyance piping and 40 separate discharge outfalls into San Francisco Bay. This combined system grew in sections from the 1940s to its maximum size in 1958, when it underwent the first in a series of separation projects. Complete separation of the combined systems was never achieved, and subsequent inspections revealed that cross-connections may still exist. Due to the evolutionary nature of the separation process, radiological contamination from the same sources may have impacted storm drain and sanitary sewer systems piping and other components. Based on historical documentation, the ROC selected for the Parcel C Phase II project area storm drain and sanitary sewer systems included cesium-137 (Cs-137), radium-226 (Ra-226), and strontium-90 (Sr-90).

The Parcel C Phase II project area storm drain and sanitary sewer systems removal action fieldwork was initiated in October 2012 and continued through September 2014. Pre-excavation field activities for the Parcel C Phase II project area removal action were initiated on October 29, 2012. During these activities, temporary fencing was installed or reconfigured, dust controls and air monitoring were implemented, and traffic was controlled and rerouted prior to initiating excavation activities. Asphalt and concrete removal was initiated in Work Area 35 in November 2012 prior to beginning excavation activities. The majority of the materials removed in the Parcel C Phase II project area were not located within radiologically impacted areas. Consequently, the asphalt and concrete from these areas were transferred to stockpiles pending recycling.

Excavation of the Parcel C Phase II project area storm drain and sanitary sewer systems was initiated on November 19, 2012 in Work Area 35, and the last truckload of soil was excavated on October 10, 2013 in Work Area 31. In total, 11,930 linear feet of storm drain and sanitary sewer systems trenches (inclusive of soil, pipes, and manholes) were excavated during the Parcel C Phase II removal action. At the completion of excavation, the total area of the exposed trench surfaces (sidewalls and bottoms) was 22,067 square meters (m²). At the completion of the storm drain and sanitary sewer systems removal action activities, a total of 28 trench survey units had been designated in Work Areas 31, 33, 34, and 35. The excavated trench survey unit depths ranged between 1 foot and 14 feet below ground surface (bgs).

During the Parcel C Phase II project area storm drain and sanitary sewer systems removal action, a total of 2,502 truckloads (approximately 30,024 cubic yards) of soil were excavated and transferred to the radiological screening yards (RSYs) for processing. The excavated soil generated during removal of the storm drain and sanitary sewer systems often included small sections of crumbled pipe and crushed manhole pieces that were radiologically processed along with the surrounding soil. In total, 3,099 soil samples were collected from the Parcel C Phase II project area storm drain and sanitary sewer systems excavated soil survey units radiologically processed in the RSYs during the removal action. These soil samples were analyzed by gamma spectroscopy in the on-site laboratory including 10 percent for quality assurance verification with 10 percent sent to the off-site laboratory for Sr-90 analysis. The final systematic soil samples from each of the excavated soil survey units were analyzed by a Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP)-accredited laboratory for definitive analysis.

Based on the laboratory analytical results, approximately 1,092 cubic yards of soil exceeding the radiological release criteria was remediated from the Parcel C project area excavated soil survey units processed in the RSYs. The remediated soil was placed in low-level radioactive waste (LLRW) bins for disposal by the DON radiological waste contractor. Radionuclide concentrations greater than the release criteria for excavated soil processed in the RSYs were limited to Ra-226 ranging from 1.486 picocuries per gram (pCi/g) to 2.250 pCi/g. One soil sample collected from the excavated soil survey unit identified as ES-779 showed the presence of Sr-90 above the release criterion at 0.361 pCi/g. None of the Parcel C Phase II project area excavated soil survey units processed in the RSYs identified the presence of Cs-137 contamination.

At the conclusion of the Parcel C Phase II project area removal action, a total of 105 screening pads containing soil generated during excavation of the storm drain and sanitary sewer systems were processed in the RSYs. None of the final 18 systematic FSS soil sample analytical results collected from each excavated soil survey unit screening pads in the RSYs identified the presence of residual ROC concentrations above the release criteria. A total of 45 radiologically processed and released excavated soil survey units were backfilled into appropriate Parcel C Phase II project area trenches. One excavated soil survey unit was placed in LLRW bins for off-site disposal by the DON radiological waste contractor. Soil from a total of 59 radiologically processed and released excavated soil survey units derived from Parcel C Phase II project area IR Program sites was transferred off-site by the DON non-LLRW contractor for disposal at a CERCLA landfill.

One radiological device was found during the Parcel C Phase II removal action activities. Device 12-WA35-B204-001 was discovered during a pre-site activity walk through adjacent to Building 204. The device was photographed, logged, and placed in the designated radiological materials area storage locker in Building 258. The device was transferred to the DON radiological waste contractor for off-site disposal on March 28, 2016.

Storm drain and sanitary sewer systems pipes and manholes (collectively called piping) were removed from the Parcel C Phase II project area during excavation of the trenches. A sufficient volume of sediment for sample collection and analysis was collected from 21 sections of pipe and 13 manholes during the Parcel C Phase II project area removal action. These 34 sediment samples were submitted to the laboratory for analysis by gamma spectroscopy. Based on the sediment sample laboratory analytical results, 15 pipe and 9 manhole sediment samples did not identify the presence of radiological contamination above the release criteria. However, the analytical results identified the presence of Cs-137 contamination in sediment samples collected from 5 sections of pipe and 1 manhole and Ra-226 contamination in sediment samples collected from one section of pipe and three manholes. The highest Cs-137 sediment concentration was identified in a pipe section excavated from trench segment 12-C34-28-8L at 0.3763 pCi/g. The highest Ra-226 sediment concentration was identified in a pipe section excavated from trench segment 12-253-28-8D (TU337) at 5.94 pCi/g. No Sr-90 concentrations above the release criterion were identified in the sediment sample laboratory analytical results. The pipe sections and materials forming the manholes containing Cs-137 or Ra-226 sediment contamination were placed in LLRW bins during the removal action activities. The bins containing the piping debris were shipped off-site by the DON radiological waste contractor as LLRW to either the U.S. Ecology facility in Idaho or the Energy Solutions facility in Clive, Utah.

During the Parcel C Phase II project area removal action, radiological survey activities were performed for 398 sections of pipe and 69 manholes. The collected data were reviewed by the Radiation Safety Officer to determine whether investigative levels had been exceeded. None of the results identified the presence of radioactivity concentrations exceeding the release criteria.

Small sections of piping were left in place following the completion of the Parcel C project area removal action due to obstructions such as active utility lines or to protect the structural integrity of stormwater outfalls. In addition, piping was left in place that will be addressed during future Parcel C removal actions.

The objective of the storm drain and sanitary sewer FSS activities was to demonstrate that identified residual radioactivity levels on the sidewalls and bottoms of the excavated trenches and within the materials used as backfill met the release criteria. In general, FSSs for every excavated trench survey unit included a 100 percent surface scan and systematic and biased static (direct) measurements. Direct surface radiation measurements were collected at each systematic sample location within the excavated trenches prior to collection of soil samples to identify the potential presence of gross contamination.

Systematic soil samples were collected from the sidewalls and bottom of each excavated trench survey unit after establishing a grid that did not exceed 1,000 m² over the exposed surfaces. A minimum of 18 systematic and discrete soil samples were collected from each trench survey unit

and submitted to the laboratory for analysis by gamma spectroscopy including 10 percent for quality assurance verification with 10 percent sent to the off-site laboratory for Sr-90 analysis. The final systematic soil samples from each of the excavated soil survey units were analyzed by a DoD ELAP-accredited laboratory for definitive analysis. The laboratory results were documented in SUPRs prepared for each trench survey unit. Each SUPR previously was provided to the U.S. Environmental Protection Agency, the California Department of Toxic Substances Control, and the Department of Public Health, Environmental Management Branch, who submitted comments that were addressed in the Final SUPRs.

During the Parcel C Phase II project area time-critical removal action, a total of 28 trench survey units were designated in Work Areas 31, 33, 34, and 35. No trench survey unit exceeded 1,000 m² in exposed surface area. A minimum of 18 systematic soil samples were collected from the exposed sidewalls and bottoms of each of the designated 28 Parcel C Phase II project area trench survey units to determine whether radionuclide contamination was present above the release criteria. The systematic soil samples were submitted under chain-of-custody to the laboratory for analysis by gamma spectroscopy. In addition, investigative samples were collected and analyzed, as needed, based on the results of trench survey activities and/or piping sediment sample analytical results.

A total of 761 soil samples were collected from the sidewalls and bottoms of the 28 designated trench survey units and analyzed by the laboratory. Of these 761 soil samples, a total of 257 were investigative and 504 were the final systematic FSS soil samples. Ra-226 contamination identified in the investigative soil sample analytical results ranged from 2.096 pCi/g to 2.898 pCi/g. None of the investigative soil samples identified the presence of Cs-137 or Sr-90 concentrations above the radionuclide-specific release criterion. Based on the analytical results, approximately 163.25 cubic yards of soil was remediated from the Parcel C Phase II project area trench survey units. The remediated soil was placed in LLRW bins pending off-site disposal by the DON radiological waste contractor to either the U.S. Ecology facility in Idaho or the Energy Solutions facility in Clive, Utah.

FSSs for every excavated trench survey unit included a 100 percent surface scan and systematic and biased static (direct) measurements. Direct surface radiation measurements were collected at each systematic sample location prior to collection of the associated soil sample to identify the potential presence of gross contamination.

During the Parcel C Phase II project area removal action FSS activities, a total of 504 systematic trench soil samples were collected from the sidewalls and bottoms of the trench survey units and analyzed by the on-site laboratory. The final 18 FSS soil samples collected from the trench survey units were subsequently submitted to the DoD ELAP-accredited laboratory for definitive analysis.

None of the 504 FSS soil samples indicated the presence of residual ROC concentrations above the release criteria.

The FSS results for the 28 trench survey units within the Parcel C Phase II project area were used for dose and risk modeling to facilitate regulatory agency concurrence for unrestricted radiological release. For dose and risk modeling efforts, storm drain and sanitary sewer systems trench survey units were composed of two different types: 1) trenches and 2) backfill material. Dose and risk modeling was performed using the default residential farmer scenario of 12 hours per day indoors and 6 hours per day outdoors occupancy as provided in the most current version of RESRAD software at the time of the modeling exercise. The results of the modeling efforts for each of the 28 designated trench survey units fall within the acceptable NCP risk management range of 10^{-6} to 10^{-4} , which support radiological free release.

The environmental as low as reasonably achievable (ALARA) process was implemented for each of the 28 Parcel C Phase II project area trench survey units during the removal action. ALARA analyses were performed based on recent estimates of dose to the public from HPNS operations. Based on qualitative ALARA analyses, excavation projects that could cause the potential dose to the public to exceed 1 millirem (individual) or 10 person-rem (collective) are subjected to quantitative ALARA analyses. To date, no TtEC operations at HPNS have resulted in an individual dose to the public greater than 1 millirem or a collective dose greater than 10 person-rem. Qualitative ALARA analyses did not result in any gamma survey count rates above the investigation levels, and none of the sample results identified ROC concentrations above the release criteria. In addition, air sampling results did not exceed 10 percent of the ROC derived air concentration for members of the public and for workers and the processed personnel dosimetry badges did not identify a single dose above background levels.

Ship Berths

The Ship Berths were identified in Volume II of the HRA (NAVSEA 2004) within the Parcel C Phase II project area. Radiological surveys were performed for the Ship Berths in accordance with the associated task-specific plan.

The objective of the surveys was to achieve radiological release for unrestricted use of the Ship Berths by demonstrating that residual ROC concentrations met the radionuclide-specific release criterion. Results were analyzed to determine whether residual radioactivity, distinguishable from background radiation, resulted in an excess lifetime cancer risk greater than the NCP acceptable risk management level of 10^{-6} to 10^{-4} , and if the residual radioactivity had been reduced to levels that were ALARA. The process for releasing the ship berths from radiological controls ensures ~~This radiological release process ensured~~ that residual radioactivity will ~~did~~ not result in individuals being exposed to unacceptable levels of radiation or radioactive materials.

Commented [MPL1]: Please reword as this sounds like activities performed under this phase of work resulted in a release to the environment.

Surveys were performed in accordance with the standard operation procedures approved for use at HPNS and the “Final Basewide Radiological Management Plan” (TtEC 2012a). The Ship Berths 1, 2, 3, 4, and 5 area was divided into 13 Class 1 survey units. Survey Units 1 through 9 were asphalt/soil survey units associated with Ship Berths 2, 3, 4, and 5 and Survey Units 10 through 13 were concrete survey units associated with Ship Berths 1 and 2. Each of the 13 survey units was less than 800 m² in area. No Class 2 survey units were associated with Ship Berths 1, 2, 3, 4, and 5. Each Class 1 survey unit received 100 percent surface scan. Following scanning and data evaluation, alpha, beta, and gamma static measurements were logged at discrete points in each survey unit. Basic statistical quantities were calculated for the data in an effort to identify patterns, relationships, and anomalies. Swipe samples for concrete surfaces were collected at each systematic static location to assess the presence of removable alpha and beta contamination. Gamma scans and static measurements were collected of the asphalt surface prior to removal to access the underlying soil survey units. Asphalt sections were disposed of as LLRW if previously covering soil was found to have ROC concentrations exceeding the release criteria. . For the soil survey units, soil samples were collected from discrete systematic static measurement locations, processed, and analyzed by gamma spectroscopy following scanning activities. In addition, results from the DoD and ELAP-accredited laboratory analyses were reviewed to ensure that the residual ROC concentrations for FSS samples were less than the release criteria. When a quality issue was identified, the associated soil samples were rejected and new soil samples were collected and analyzed to ensure the integrity and verification of the numerical results.

The radiologically impacted Parcel C Phase II Ship Berths were subjected to ALARA review before fieldwork was initiated to ensure that radiation exposures to workers, the public, and the environment met ALARA principles. ALARA reviews were conducted for all operations, practices, and procedures with the potential for individual or collective doses. Data analyses were performed for alpha, beta, and gamma radiation to ensure that any possible radioactive contamination was identified. Following the completion of the survey activities, the qualitative radiological impacts from operations in the field were evaluated by performing dose and risk assessments. These results were provided to the ~~Radiological Affairs Support Office~~ DON and regulatory agencies for review. Based on qualitative ALARA analyses, site survey projects that could cause the potential dose to the public to exceed 1 millirem (individual) or 10 person-rem (collective) were subjected to quantitative ALARA analyses.

Following the completion of the survey activities for the Ship Berths, dose and risk modeling was performed. To calculate the excess lifetime cancer risk and residual dose, the residential farmer scenario in RESRAD Version 6.5 was used for Survey Units 1 through 9. For Survey Units 10 through 13, the building occupancy scenario in RESRAD-BUILD Version 3.5 was used. Based on the results of the dose and risk models, the Ship Berths were recommended for radiological release for unrestricted use. Concurrence for the Ship Berths is expected in the near future.

Commented [MPL2]: Navy

Conclusions

The objective of the Parcel C Phase II project area removal action was to protect the public health and welfare, and the environment from actual or potential releases of radiologic contaminants by preventing exposure to residual ROC in concentrations that exceed remediation goals for all the ingestion or inhalation exposure pathways, and achieve the radiological release for unrestricted use of the Parcel C Phase II project area Ship Berths 1, 2, 3, 4, and 5, and storm drain and sanitary sewer systems trenches. As demonstrated by the information presented in each of the 28 SUPRs and summarized in this RCSR, none of the final 18 systematic FSS soil samples collected from each of the designated trench survey units or the excavated soil survey units and/or imported fill used as backfill material identified the presence of residual ROC concentrations above the release criteria identified in the AM (DON 2006), the remediation goals established in the ROD (DON 2010), or the NORM Abstract (TtEC 2017).

Selected storm drain and sanitary sewer systems in Work Areas 31, 33, 34, and 35 have been removed. Additional storm drain and sanitary sewer systems in Work Areas 31, 33, 34, and 35 will likely be removed under future contracts.

Regulatory concurrence for the Ship Berths is expected in the near future. The information and data presented in this RCSR, each of the 28 SUPRs, and the FSS report confirm the DON's conclusion that the Parcel C Phase II project area removal action resulted in a reduction of the potential risks to levels below the radiological RAO, and no further radiological activities are recommended for the 28 storm drain and sanitary sewer trench survey units and Ship Berths 1, 2, 3, 4, and 5.

Commented [MPL3]: External exposure wasn't an objective?

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ABBREVIATIONS AND ACRONYMS

AEC	Atomic Energy Commission
ALARA	as low as reasonably achievable
AM	Action Memorandum
ARAR	applicable or relevant and appropriate requirement
ASTM	American Society for Testing and Materials
bgs	below ground surface
cc	cubic centimeter
CDPH	California Department of Public Health, Environmental Management Branch
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CIP	cast iron pipe
cm ²	square centimeter
COC	chain of custody
Cs-137	cesium-137
CSM	Conceptual Site Model
CSO	Caretaker Site Office
CTO	Contract Task Order
DCGL	derived concentration guideline level
DoD	Department of Defense
DON	Department of the Navy
dpm	disintegrations per minute
DTSC	(California) Department of Toxic Substances Control
ELAP	Environmental Laboratory Accreditation Program
EPA	U.S. Environmental Protection Agency
FSS	Final Status Survey
GPS	Global Positioning System
HASL	(Department of Energy) Health and Safety Laboratory
HPNS	Hunters Point Naval Shipyard
HRA	Historical Radiological Assessment
IR	Installation Restoration (Program)

ABBREVIATIONS AND ACRONYMS

(Continued)

keV	kiloelectron volt
LLRW	low-level radioactive waste
m ²	square meter
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDL	method detection limit
mrem/y	millirem per year
NaI	sodium iodide
NAVFAC	Naval Facilities Engineering Command
NAVSEA	Naval Sea Systems Command
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NORM	naturally occurring radioactive material
NRC	Nuclear Regulatory Commission
NRDL	Naval Radiological Defense Laboratory
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
pCi/g	picocuries per gram
Pu-239	plutonium-239
PVC	polyvinyl chloride
Ra-226	radium-226
RAO	remedial action objective
RASO	Radiological Affairs Support Office
RCP	reinforced concrete pipe
RCSR	Radiological Construction Summary Report
ROC	radionuclides of concern
ROD	Record of Decision
ROICC	Resident Officer in Charge of Construction
RSO	Radiation Safety Officer
RSY3	Radiological Screening Yard 3
RSY4	Radiological Screening Yard 4
SAP	Sampling and Analysis Plan

ABBREVIATIONS AND ACRONYMS

(Continued)

SARA	Superfund Amendments and Reauthorization Act of 1986
SFRA	San Francisco Redevelopment Agency
SOP	standard operating procedure
Sr-90	strontium-90
SUPR	Survey Unit Project Report
SVOC	semivolatile organic compound
Th-232	thorium-232
TtEC	Tetra Tech EC, Inc.
TU	Trench Survey Unit
UC1	Utility Corridor 1
UC2	Utility Corridor 2
UC3	Utility Corridor 3
UCP	unreinforced concrete pipe
VCP	vitreous clay pipe
VOC	volatile organic compound
VSP	Visual Sample Plan

1.0 INTRODUCTION

The U.S. Department of the Navy (DON) directed Tetra Tech EC, Inc. (TtEC) to prepare this Radiological Construction Summary Report (RCSR) to describe and summarize the Parcel C Phase II project area Ship Berths 1, 2, 3, 4, and 5 Final Status Survey (FSS) activities, and storm drain and sanitary sewer time-critical removal action at Hunters Point Naval Shipyard (HPNS) located in San Francisco, California (Figure 1-1). The Parcel C Phase II project area radiological activities were performed to protect the public health and welfare, and the environment from actual or potential releases of radiologic contaminants. The results of the implemented removal action activities are summarized in this RCSR. Except in relation to reuse as potential backfill material or waste characterization for disposal of excavated soil generated during removal of the Parcel C Phase II project area storm drain and sanitary sewer systems selected by the DON, this RCSR did not address chemical contamination and did not include or affect any other designated HPNS parcels.

The Parcel C Phase II project area includes Ship Berths 1, 2, 3, 4, and 5 as well as selected storm drain and sanitary sewer systems within Work Areas 31, 33, 34, and 35. Not all of the storm drain and sanitary sewer systems were addressed under the first or second phases of the Parcel C time-critical removal action. The first phase of the Parcel C removal action radiological activities were addressed in the Final Radiological Construction Summary Report, Parcel C Radiological Remediation and Support (TtEC 2016). The remainder of the Parcel C storm drain and sanitary sewer systems may be addressed by the DON during future Parcel C removal actions. In addition, this RCSR does not include radiologically impacted Building 205 and associated discharge channel, or Buildings 211, 224, or 253 located within Parcel C. These structures and associated storm drain and sanitary sewer systems piping likely will be addressed by the DON during future Parcel C time-critical removal action activities.

The Parcel C Phase II project area removal action activities were directed by the DON, Naval Facilities Engineering Command Southwest (NAVFAC) with the support of the Radiological Affairs Support Office (RASO) under Contract No. N62473-10-D-0809 and Contract Task Order (CTO) No. 0012. The Parcel C Phase II project area time-critical removal action was performed in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986 and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

1.1 HUNTERS POINT NAVAL SHIPYARD LOCATION AND DESCRIPTION

The HPNS site lies entirely within the corporate boundaries of the County of San Francisco, at the southeast corner of the City of San Francisco, California (Figure 1-1). The site encompasses

approximately 848 acres including about 416 acres on land situated on a 2-mile-long promontory projecting southeastward into San Francisco Bay. The remaining 432 acres constitute the adjacent offshore areas.

In 1992, the DON divided HPNS into five contiguous parcels (A through E) to expedite remedial action activities and land reuse. Parcel F was designated in 1996 and encompasses the offshore areas. The DON designated the landfill area in Parcel E as Parcel E-2 in September 2004. In 1997 and 2002, the boundaries of Parcels B and C were redefined, and Installation Restoration (IR) Program sites IR-06 and IR-25 were removed from Parcel B and added to Parcel C. Subsequently, Parcel A was transferred to the City and County of San Francisco for development. In July 2008, the DON again divided HPNS into eight parcels (B, C, D-1, D-2, E, E-2, G, and F) and three utility corridors identified as Utility Corridor 1 (UC1), Utility Corridor 2 (UC2), and Utility Corridor 3 (UC3) (Figure 1-2). Parcels B, C, D-1, D-2, E, E-2, G, UC1, UC2, and UC3 encompass the onshore areas.

Based on the HPNS radiological operational history described in the final “Historical Radiological Assessment, Volume II” (HRA) prepared by the Naval Sea Systems Command (NAVSEA) in 2004 (NAVSEA 2004) and site-specific investigative data, the DON determined that potential low-level radioactive contamination in soils and debris at HPNS required a response action. This decision was documented in the final “Base-wide Radiological Removal Action, Action Memorandum” (AM) (DON 2006). The AM was revised and updated to implement the recommendations of the HRA (NAVSEA 2004).

1.2 PARCEL C DESCRIPTION

Parcel C is located in the northeast-central quadrant of HPNS and includes approximately 73 acres of shoreline and lowlands (Figure 1-2). The western portion of Parcel C comprises the original promontory, with native soil over shallow bedrock, while the majority of Parcel C is situated in the lowlands with surface elevations between zero and ten feet above mean sea level. The lowlands were constructed by placing borrowed fill material from various sources, which included crushed serpentinite bedrock from the adjacent highland, construction debris, and waste materials. The serpentinite bedrock and bedrock-derived fill material consist of minerals that naturally contain asbestos and relatively high concentrations of arsenic, manganese, nickel, and other metals.

The Parcel C geologic setting includes the following geologic units, from youngest (shallowest) to oldest (deepest):

- Artificial Fill
- Undifferentiated Upper Sand Deposits
- Bay Mud Deposits

- Undifferentiated Sediments
- Bedrock

The hydrostratigraphic units at Parcel C are the A-aquifer, the Bay Mud aquitard zone, the B-aquifer, and a bedrock water-bearing zone. The general groundwater flow at HPNS is radially away from the City of San Francisco property to the north (formerly Parcel A) and toward the shoreline. The general direction of Parcel C groundwater flow is toward the east where groundwater discharges into the San Francisco Bay and southeast or northeast, directly toward the Bay or drydocks, at the perimeter locations.

Parcel C was divided into five work areas (Work Areas 31, 32, 33, 34, and 35) to expedite the storm drain and sanitary sewer removal action schedule and tracking activities (Figure 1-3). The majority of the Parcel C storm drain and sanitary sewer systems were addressed during the Phase I removal action and included North Pier. Phase II of the removal action focused on those storm drain and sanitary sewer systems pipelines in Work Areas 31, 33, 34, and 35 that were not removed as part of the Parcel C Phase I removal action. The remaining Parcel C storm drain and sanitary sewer systems pipelines and radiologically impacted Buildings 205, 211, 224, and 253 may be addressed by the DON during future removal actions.

The Parcel C Phase II project area incorporates Ship Berths 1, 2, 3, 4, and 5, which were identified in Volume II of the HRA (NAVSEA 2004) as radiologically impacted. Buildings 211, 224, and 253, and Building 205 and associated discharge channel also were identified in Volume II of the HRA as radiologically impacted; however, these four buildings and the discharge channel are outside the Parcel C Phase II project area.

No threatened or endangered species are known to inhabit Parcel C. The Parcel C ecology is limited to plant and animal species adapted to an industrial environment. Viable terrestrial habitat is inhibited at Parcel C because more than 90 percent of the ground surface is covered by pavement and former industrial buildings.

Eight IR Program sites are associated with the Parcel C Phase II project area including IR-06, IR-10, IR-24, IR-25, IR-28, IR-29, IR-57, and IR-58. These IR Program Sites are discussed in Section 3.4 of this RCSR.

1.2.1 Parcel C Current and Future Land Use

The Parcel C Phase II project area is currently unoccupied. According to the San Francisco Redevelopment Agency (SFRA) Redevelopment Plan for HPNS (SFRA 1997), the Parcel C Phase II project area (including Ship Berths 1, 2, 3, 4, and 5) was to be subdivided into blocks and zoned for educational, cultural, mixed use, research and development, industrial, maritime-industrial, and

open space. The 2010 amendment to the Redevelopment Plan (SFRA 2010) indicates that the future land use in Parcel C will include:

- HPNS Shoreline Open Space
- Shipyard North Residential
- Shipyard Village Center Cultural
- Shipyard Research and Development

1.3 PHOTOGRAPHS

The fieldwork performed during the Parcel C Phase II project area radiologic activities was documented using a photographic record. Photographs of typical operations, processes, and procedures performed during the radiologic fieldwork are provided in this RCSR prior to the appendices.

1.4 PURPOSE AND ORGANIZATION OF REPORT

The purpose of this RCSR is to describe and summarize the second phase of the Parcel C time-critical removal action performed to protect the public health and welfare, and the environment from actual or potential releases of radiologic contaminants and document the results. This RCSR is organized as follows:

- **Section 1.0 Introduction** – Section 1.0 provides general information including descriptions of HPNS and the Parcel C Phase II project area, the current and future land use of the property, fieldwork photographic documentation, and the purpose and organization of this RCSR document.
- **Section 2.0 Background** – Section 2.0 places the Parcel C Phase II project area within context of HPNS by presenting an abbreviated history of the storm drain and sanitary sewer systems, discussing the transport of radionuclides at HPNS, identifying the release criteria and remediation goals, and summarizing the various documents that support the radiological work performed.
- **Section 3.0 Parcel C Project Area Overview** – Section 3.0 provides an overview of both the storm drain and sanitary sewer systems removal action and the FSS activities for Ship Berths 1, 2, 3, 4, and 5. This section summarizes procedures for performance of the radiological work activities, identifies those activities common to each of the trench survey units and Ship Berths 1, 2, 3, 4, and 5, discusses the IR Program sites associated with the Parcel C Phase II project area, and summarizes archaeological monitoring activities.
- **Section 4.0 Work Area 31** – Section 4.0 summarizes the storm drain and sanitary sewer systems removal action activities performed in Work Area 31 for Trench Survey Units 321, 322, 328, 332, and 339.

- **Section 5.0 Work Area 33** – Section 5.0 summarizes the storm drain and sanitary sewer systems removal activities performed in Work Area 33 for Trench Survey Units 315, 316, 317, 318, 319, 320, 329, 330, 331, and 338.
- **Section 6.0 Work Area 34** – Section 6.0 summarizes the storm drain and sanitary sewer systems removal action activities performed in Work Area 34 for Trench Survey Units 323, 324, 325, 326, 327, 336, and 337.
- **Section 7.0 Work Area 35** – Section 7.0 summarizes the storm drain and sanitary sewer systems removal action activities performed in Work Area 35 for Trench Survey Units 312, 313, 314, 333, 334, and 335.
- **Section 8.0 Ship Berths 1, 2, 3, 4, and 5** – Section 8.0 summarizes the FSS activities performed for the Parcel C Phase II Ship Berths 1, 2, 3, 4, and 5.
- **Section 9.0 Parcel C Phase II Site Restoration Activities** – Section 9.0 describes the site restoration activities completed during the second phase of the Parcel C removal action.
- **Section 10.0 Parcel C Phase II Project Area Removal Action Cost Summary** – Section 10.0 summarizes the estimated costs associated with implementation and completion of the Parcel C Phase II project area removal action.
- **Section 11.0 Conclusions** – Section 11.0 presents the conclusions to the Parcel C Phase II project area removal action activities.
- **Section 12.0 References** – Section 12.0 lists the documents and references cited in the Parcel C Phase II project area RCSR.
- **Appendices A through P** – The individual appendices present information and technical data gathered during the performance of the storm drain and sanitary sewer systems removal action and the Ship Berths 1, 2, 3, 4, and 5 FSS activities and other documents that support the conclusion presented in this RCSR.

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2.0 BACKGROUND

The following sections provide an abbreviated history and pertinent background information leading to the development of the HPNS Conceptual Site Model (CSM). Included are brief descriptions of the supporting documents and reports that guided the Parcel C Phase II project area storm drain and sanitary sewer systems time-critical removal action and the radiologically impacted Ship Berths 1, 2, 3, 4, and 5 work activities.

2.1 HISTORY

The DON obtained ownership of HPNS for shipbuilding, repair, and maintenance in 1940. HPNS began using radioactive materials in shipyard operations and Naval Radiological Defense Laboratory (NRDL) research projects in the early 1940s. Operations at HPNS included ship decontamination, repair, and dismantling activities that generated radium dial and sandblast grit waste streams. In addition, the DON managed a waste disposal program that included the removal of radioactive materials from HPNS. Between 1946 and 1947, HPNS operations included decontamination activities on ships used during OPERATION CROSSROADS nuclear weapons tests. NRDL activities and projects involved research into decontamination methods, personnel protection, development of radiation detection instrumentation, effects of radiation on living organisms and natural and synthetic materials, and experimentation in decontamination methodologies. The NRDL research projects ended in 1969, and the associated buildings were decontaminated and cleared for unrestricted reuse based on the standards in place at that time. The DON deactivated HPNS operations in 1974 and the property remained largely unused until 1976. HPNS was leased to Triple A Machine Shop, Inc., a private ship repair company, from 1976 to 1986 when its tenancy was terminated. The DON resumed occupancy of HPNS in 1987.

The present-day configuration of the storm drain and sanitary sewer systems at HPNS is the result of an evolutionary process. These systems were originally designed and built in the 1940s as a combined system, using the same conveyance piping and 40 separate discharge outfalls into San Francisco Bay. This combined system grew in sections from the 1940s to its maximum size in 1958, when it underwent the first in a series of separation projects. The purpose of the separation projects was to provide for installation of dedicated sanitary sewer piping and pump stations that would discharge sanitary sewer effluent off-site to a publicly-owned treatment plant operated by the City and County of San Francisco. A sewage lift station was constructed specifically for conveyance of much of the sanitary sewage; however, stormwater flows from heavy rains would overwhelm the sewage lift station, and much of the sewage and stormwater diverted to various existing outfalls into San Francisco Bay (DON 2008).

Separation of the storm drain and sanitary sewers involved installation of dedicated sanitary sewer collection piping or diversion structures within the combined system. A total of 28 San Francisco

Bay outfalls were converted for exclusive use as stormwater outlets, while 12 continued to serve as combined outlets. In 1973, the second separation project was undertaken including the removal of some of the stormwater outfalls from the South Basin area, just offshore from the Parcel E shoreline. The last of the separation projects was completed in 1976 and involved the installation of additional dedicated sanitary sewer piping. Complete separation of the combined systems was never achieved, and subsequent inspections revealed that cross-connections may still exist. Due to the evolutionary nature of the separation process, radiological contamination from the same sources may have impacted storm drain and sanitary sewer systems piping and other components.

As a result of the historical radiological operations at HPNS, some buildings, storm drain and sanitary sewer lines, soil, debris, and slag material have indicated the potential presence of low-level radioactive contamination. Hazardous materials also have been found at HPNS. Pursuant to CERCLA, as amended by SARA, HPNS was placed on the National Priorities List in 1989.

2.2 PARCEL C HISTORY

Parcel C historically included about 79 acres in the central portion of HPNS and 70 buildings. Formerly part of the industrial support area, Parcel C was used for shipping, ship repair, and office and commercial activities. Industrial support facilities for ship repair dominated the land use at Parcel C and included the following:

- Foundry
- Power plant
- Sheet manufacturing shop
- Paint shop
- Various machine shops

The Parcel C drydocks were formerly part of the industrial production area and portions of Parcel C were used by NRDL. The boundaries of Parcels B and C were redefined in 1997 and 2002 to incorporate IR-06 and IR-25 into Parcel C. In 2008, the DON divided Parcel C into Parcels C and UC2. In its current configuration, Parcel C encompasses about 73 acres. Parcel C environmental investigations began in 1984. The Draft Final Remedial Investigation Report for Parcel C was completed in 1997; the Draft Final Remedial Investigation for Parcel B, which covered IR-06 and IR-25, was completed in 1996. The revised Final Feasibility Study Report for Parcel C was completed in 2008 and the “Final Record of Decision for Parcel C, Hunters Point Shipyard, San Francisco, California” (ROD) (DON 2010) was completed in September 2010.

Radiologically impacted sites associated with the former use of general radioactive materials and decontamination of ships used during the 1946 atomic weapons testing in the South Pacific were identified by the DON for Parcel C and documented in Volume II of the HRA (NAVSEA 2004).

The radiologically impacted sites included Buildings 203, 205 and discharge tunnel, 211, 214, 224, 241, 253, 271, and 272, and the storm drains and sanitary sewer systems.

2.3 CONCEPTUAL SITE MODEL

A CSM is a description of a site and its environs and includes a hypothesis regarding the potential routes of migration of contaminants to the public and the environment. Descriptions of Parcel C are provided in Sections 2.1 and 2.2. The potential routes of migration are described in detail in the following paragraphs.

The CSM is based on the supposition that radioactive materials likely were discharged from numerous locations throughout HPNS into the storm drain and sanitary sewer systems and may have been released into surrounding soils during the course of normal operations and maintenance or repair activities (DON 2008). The radioactive material potentially present at HPNS likely were the result of:

- Burial along with excavated fill materials while increasing the footprint of HPNS
- Residue from decontamination of ships or workers
- Residual contamination as a result of NRDL experiments or tests in structures or land areas
- Residual contamination from shipyard operations
- Release into sanitary sewers and storm drains

Manholes at HPNS have been found to be constructed of porous concrete and/or brick, likely resulting in the transport of contamination into the surrounding soil. Piping at HPNS generally was composed of:

- Cement asbestos pipe
- Reinforced concrete pipe (RCP)
- Unreinforced concrete pipe (UCP)
- Ductile iron pipe
- Vitreous clay pipe (VCP)
- Cast iron pipe (CIP)
- Fiberglass pipe
- Corrugated metal pipe
- Steel pipe
- Perforated metal pipe

- Polyvinyl chloride (PVC) plastic pipe
- Concrete-encased VCP

Typically, the storm drain and sanitary sewer systems pipe sections were connected at HPNS by unsealed slip fittings at joints. Some leakage from the piping was anticipated when the storm drain and sanitary sewer systems were installed. Historical information indicates that the storm drain and sanitary sewer systems often were cleaned by power washing that may have forced radiological contamination out of the piping into the surrounding soils. The most recent power washing event was performed at HPNS in 1999. Power washing of these old sewer systems may easily have caused further cracks or breaks in the piping and subsequent migration of contamination into the surrounding soil. The migration and extent of radiological soil contamination at HPNS likely depended on how and where releases from the storm drain and sanitary sewer systems occurred.

The HPNS storm drain and sanitary sewer systems removal actions performed throughout Parcels B, C, D-2, E, G, UC1, UC2, and UC3 support the accuracy of the CSM. Similar types of fill materials were found in the excavated trenches and no waste materials were discovered during excavation. Identified radiological contamination has been found primarily in excavated soil at HPNS. There has been little indication of historical spills or accidental releases based on the historical research performed and radiological site investigations (DON 2008).

2.4 REMOVAL ACTION OBJECTIVE AND REMEDIATION GOALS

Based on the radiological operational history described in Volume II to the HRA (NAVSEA 2004), the DON determined that low-level radioactive contamination potentially present in some buildings, storm drain and sanitary sewer systems lines, soil, debris, and slag material at HPNS required a response action. This decision was documented in the final AM (DON 2006). The purpose of the AM was to document the DON's decision to perform time-critical removal actions at areas throughout HPNS that could contain localized radiologic contamination and substantially reduce exposure to surrounding populations and nearby ecosystems.

Presented in Appendix A of the AM (DON 2006), the DON identified the applicable or relevant and appropriate requirements (ARARs) for the HPNS removal actions. Only those standards identified by the State of California that were more stringent than federal requirements became ARARs. The remediation goals for localized radiologic contamination at HPNS as presented in the AM are considered to be the most conservative available and were developed based on the ARARs.

The radiological release criteria established in the AM (DON 2006) are based on the Nuclear Regulatory Commission (NRC) 125 millirems per year (mrem/y) dose or were otherwise risk-based. The AM release criteria are presented in this RCSR as Table 2-1.

Commented [MS4]: The radiological release criteria in the AM are from NRC NUREG-1757 that were then scaled down from 25 mrem/y to 15 mrem/y. The original values listed in NUREG-1757 were multiplied by (15/25) i.e. 0.6, see footnote "b" to Table 6-1 in the AM. Text adjusted...

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The HRA (NAVSEA 2004) listed cesium-137 (Cs-137), radium-226 (Ra-226), and strontium-90 (Sr-90) as the radionuclides of concern (ROC) for the storm drain and sanitary sewer systems. The ROC associated with radiologically impacted Parcel C Phase II Ship Berths 1, 2, 3, 4, and 5 included Cs-137, plutonium-239 (Pu-239), Ra-226, and Sr-90.

The Parcel C ROD (DON 2010) was prepared to present the selected remedies to remediate soil, groundwater, and radiologically impacted soil structures. The ROD was developed and the remedies selected in accordance with CERCLA as amended by SARA and, to the extent practicable, the NCP. The DON, U.S. Environmental Protection Agency (EPA), California Department of Toxic Substances Control (DTSC), and the San Francisco Bay Regional Water Quality Control Board concurred with the selected remedies for Parcel C.

The CERCLA remedial actions selected in the Parcel C ROD (DON 2010) were necessary to protect the public health and welfare, and the environment from actual or potential releases of contaminants from this site. The ROD addresses radionuclides in soil and structures such as buildings, sites, and storm drain and sanitary sewers in addition to other chemical contaminants. The discussions in this RCSR are limited to radionuclide contamination in soil and structures and do not address other chemical contaminants that may be present in Parcel C.

Remedial action objectives (RAOs) for Parcel C were established based on regulatory requirements, standards, and guidance; contaminated media; contaminants of concern; potential receptors and exposure scenarios; and human health and ecological risks. The success of the remedial actions ultimately is measured by their ability to meet the RAOs. As identified in the ROD (DON 2010), the radiological RAO for Parcel C was to prevent or minimize exposure to ROC in concentrations that exceed remediation goals for all potentially complete exposure pathways. The radiological remediation goals for the Parcel C ROC were listed in Table 5 of the ROD (DON 2010) and are presented in this RCSR as Table 2-2.

As indicated in the Parcel C ROD (DON 2010), the time-critical removal action selected to address potential radioactive contamination included:

- Surveying structures, former building sites, and radiologically impacted areas
- Decontaminating buildings
- Excavating storm drain and sanitary sewer lines, and excavating outdoor and radiologically impacted areas
- Disposing of excavated materials and soils at off-site facilities
- Conducting surveys to ensure that remediation goals are met for radiologically impacted sites scheduled for unrestricted release
- Decontaminating or removing structures below Building 205

Commented [MPL6]: Typo?

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The objective of the Parcel C Phase II project area removal action described in this RCSR was to:

- Protect the public health and welfare, and the environment from actual or potential releases of radiological contaminants
- Prevent exposure to residual ROC in concentrations that exceed the release criteria and remediation goals for the ingestion or inhalation exposure pathways
- Achieve radiological release for unrestricted use of Ship Berths 1, 2, 3, 4, and 5 and the selected storm drain and sanitary sewer lines in Work Areas 31, 33, 34, and 35

This objective was achieved by meeting the radiological release criteria identified in the AM (DON 2006) and the radiological RAO established in the ROD (DON 2010).

As summarized in Section 2.5.8, naturally occurring radiological material (NORM) was found during the excavation of several of the Parcel C Phase II trench survey units. This bedding sand was used to support the storm drain and sanitary sewer system piping and has a unique geological signature. Those trench survey units with documented NORM fill materials used specific release criteria established during the DON's investigation into the composition of the bedding sand. The release criteria specified for those trench survey units containing NORM fill material are identified in Table 2-4.

2.5 SUPPORTING DOCUMENTS SUMMARY

The following sections summarize the relevant supporting plans and other documents necessary to facilitate and complete the Parcel C Phase II project area radiological removal action activities. No deviations to these plans were implemented during the removal action. Each of these supporting documents is incorporated by reference into this RCSR and is available for review through the Administrative Record.

2.5.1 Basewide Radiological Management Plan

The radiological work activities for the Parcel C Phase II project area were performed using guidance established in the final "Basewide Radiological Management Plan, Hunters Point Naval Shipyard, San Francisco, California" (Radiological Management Plan) (TtEC 2012a). This document superseded the original "Base-wide Radiological Work Plan, Revision 1, Hunters Point Shipyard, San Francisco, California" (TtEC 2007b). The Radiological Management Plan (TtEC 2012a) provided guidance for:

- Radiological training
- Various work control procedures
- Radiological survey types, classifications, and selection
- Survey planning and implementation

- Results assessment and decision making
- Release criteria and investigation levels
- Field and laboratory instruments and instrumentation equations
- Decontamination, dismantling, remediation, and disposition
- Radioactive materials management
- Documentation and records management
- Storm drain and sanitary sewer removal action activities

The procedures and methodologies outlined in the Radiological Management Plan were applicable to the work performed for the radiologically impacted buildings, sites, structures, and areas at HPNS, as well as other HPNS-wide support functions. In addition, the Radiological Management Plan included the “Basewide Storm Drain and Sanitary Sewer Removal Plan, Hunters Point Naval Shipyard, San Francisco, California” (Sewer Plan) (TtEC 2012a) as Attachment 1. The Sewer Plan is described in Section 2.5.1.1 of this RCSR.

2.5.1.1 Basewide Storm Drain and Sanitary Sewer Removal Plan

The Parcel C Phase II project area storm drain and sanitary sewer removal action activities were performed using guidance established in the Sewer Plan, Attachment 1 to the Radiological Management Plan (TtEC 2012a). The Sewer Plan (TtEC 2012a) incorporated the revisions and updates to the original “Base-Wide Storm Drain and Sanitary Sewer Removal Work Plan, Hunters Point Shipyard, San Francisco, California” (TtEC 2006a) and its subsequent revisions (TtEC 2007a; 2008a and c; 2010).

The Sewer Plan (TtEC 2012a) presented the overall scope and approach for performing storm drain and sanitary sewer removal activities at HPNS and achieving radiological release of the excavated and backfilled trench areas. The general approach to removing and achieving radiological release of the impacted storm drain and sanitary sewer systems as described in the Sewer Plan (TtEC 2012a) was to:

- Excavate soil to a minimum depth of 1 foot below and to each side of the pipe and transfer the material to one of the designated radiological screening yards (RSY) identified as RSY3 and RSY4 for processing
- Remove the pipelines
- Plug open sewer or storm drain lines left in place during the removal process to prevent water from entering or exiting pipes
- Conduct radiological screening and sampling of the piping
- Perform FSS activities on excavated soils and exposed excavation trench surfaces

- Backfill the trench survey units and perform site restoration

The Sewer Plan specified that the FSS activities for every excavated storm drain and sanitary sewer trench section include a 100 percent surface scan and the collection of systematic and biased static measurements, as appropriate. Following excavation, systematic soil samples were collected after establishing a grid that did not exceed 1,000 square meters (m²) over the exposed trench surface. A minimum of 18 systematic sample locations, based on a random start point and a triangular grid pattern, were generated using Visual Sample Plan (VSP) software (PNL 2007). Sample collection points were placed in the field using approved land surveying technologies and identified with the Global Positioning System (GPS). Systematic soil samples were analyzed for radionuclides by gamma spectroscopy with 10 percent of the samples analyzed for Sr-90. The FSS results were used for dose and risk modeling and these results were used to facilitate regulatory agency concurrence for radiological release for unrestricted use.

The Sewer Plan (TtEC 2012a) provided the procedures and methodologies for performing the HPNS-wide storm drain and sanitary sewer systems removal actions including:

- Establishing trench survey units and backfill material survey units
- Data quality objectives
- Statistical tests
- Field implementation including permitting and notifications
- Design Plans
- Environmental Protection Plans
- Geophysical surveys and topographic land surveying
- Stormwater, sediment, and erosion control
- Waste classification, storage, and disposal
- Traffic control plans
- Equipment and material surveys
- Personnel surveys
- Well destruction
- Excavation in non-radiologically and radiologically impacted areas
- RSY excavated soil processing and FSS activities
- Surveys of storm drain and sanitary sewer systems, piping, and piping left in place
- Excavated trench surveys and FSS activities
- Backfill placement and compaction

- Site restoration

In accordance with the Sewer Plan (TtEC 2012a), most storm drain and sanitary sewer piping within each parcel or area were to be removed, although some piping could be left in place to be addressed at a later date and limited piping could be left in place permanently. Specifically, piping laterals originating at non-radiologically impacted buildings would only be removed within the first 10 feet of their union with a main trunk line. If radiological contamination was not present in this segment of the line, the exposed ends of the lateral were capped or plugged and the remaining section left in place. If evidence of radiological contamination was encountered, the remaining lateral was removed to the extent practicable. In addition, piping located within 10 feet of a building or other obstruction was left in place to protect the integrity of the structure and to ensure the health and safety of workers and tenants. Throughout this RCSR, the 10-foot area extending outward from the exterior of the Parcel C Phase II project area structures is referred to as “the 10-foot buffer zone”. Storm drain and sanitary sewer systems pipes within the 10-foot buffer zone surrounding non-radiologically impacted structures within the Parcel C Phase II project area were not included in the estimated linear feet of piping remaining in place.

2.5.2 Basewide Archaeological Monitoring and Discovery Plan

The final “Basewide Archaeological Monitoring and Discovery Plan” (Archaeological Plan) (TtEC 2012b) was prepared to apply to those activities agreed upon between the DON and the California State Historic Preservation Office that will occur at HPNS under the 1998 Base Realignment and Closure program. The Archaeological Plan provided a context for the cultural resources of HPNS and guidance for archaeological monitoring during removal and remedial actions. To comply with the substantive requirements of Section 106 of the National Historic Preservation Act for removal and remedial actions undertaken at HPNS, the DON directed the preparation of the Archaeological Plan and monitoring of the fieldwork by a qualified archaeologist, as required on a case-by-case basis. The document delineated those areas at HPNS requiring monitoring during preconstruction activities or because of archaeological sensitivity. In addition, the document outlined procedures for identifying and treating resources discovered during invasive field activities and the treatment of human remains and grave-associated artifacts. The results of the archaeological monitoring activities performed for the Parcel C Phase II project area are described in Section 3.3 of this RCSR.

2.5.3 Final Survey Unit Project Reports Abstract

The “Final Survey Unit Project Reports Abstract for Sanitary Sewer and Storm Drain Removal Conducted After September 1, 2012, Hunters Point Naval Shipyard, San Francisco, California” (SUPR Abstract) (TtEC 2013) was prepared to summarize the scope, approach, and radiological surveys used during removal of the storm drain and sanitary sewer systems at HPNS after September 1, 2012. The SUPR Abstract (Appendix A) was used to support preparation of the final

“Execution Plan, Parcel C Phase II, Radiological Remediation and Support” (Execution Plan) (TtEC 2012c) discussed in Section 2.5.6.

To reduce the level of detail typically redundant to each Survey Unit Project Report (SUPR), the SUPR Abstract was developed as an overarching document that provided information and details common to each of the numerous trench survey units throughout HPNS. The SUPR Abstract was revised as state-of-the-art laboratory methodologies and quality assurance procedures were refined. This document was applicable to the HPNS storm drain and sanitary sewer systems trench survey unit SUPRs and data sets prepared for regulatory review.

The SUPR Abstract provided a history of the storm drain and sanitary sewer systems at HPNS and documentation of the site’s operational history. The SUPR Abstract also presented detailed discussions and common information related to storm drain and sanitary sewer systems removal actions at HPNS including:

- Release limits
- As low as reasonably achievable (ALARA) process
- ROC and associated release criteria
- Investigation levels for gamma scan surveys
- FSS objectives, design, and methodology
- RSY processing of excavated soil
- Imported fill sources, screening, and analytical results
- Reference areas
- Sample collection methodologies and laboratory analyses including gamma spectroscopy analytical flags and total strontium/Sr-90 analysis
- Uncertainty analysis
- Data assessment (verification, validation, and evaluation)
- Statistical tests including decision errors and use of the Wilcoxon Rank-sum Test
- Dose and risk modeling
- Recommendation of final unrestricted release and SUPR preparation

The release criteria for storm drain and sanitary sewer systems soil ROC, as presented in the SUPR Abstract, are reproduced as Table 2-3 in this RCSR and include residual doses for both outdoor workers and residents.

2.5.4 Radiological Addendum to the Revised Feasibility Study for Parcel C

The “Final Radiological Addendum to the Revised Feasibility Study Report for Parcel C, Hunters Point Shipyard, San Francisco, California” (Addendum) (TtEC 2008b) was submitted to the regulatory agencies on June 20, 2008. The DON directed TtEC to prepare this Addendum to address potential radiologic contamination in buildings, former building sites, soil, groundwater, and storm drain and sanitary sewer systems within Parcel C and provide information to support the Proposed Plan and ROD (DON 2010) by re-evaluating remedial alternatives that may pose a radiological risk.

The purpose of the Addendum was to provide decision-makers and stakeholders with the information necessary to select a final remedy for radiologically impacted Buildings 203, 205 and its discharge channel, 211, 214, 224, 241, 253, 271, and 272, and the Parcel C storm drain and sanitary sewer systems. The steps used to achieve this purpose included:

- Development of a CSM that summarized the HPNS and Parcel C historical background, nature of the contaminant release, impacted environmental media, fate and transport of ROC in the environment, potential receptors and exposure pathways, and a risk assessment
- Development of RAOs for radioactively contaminated media
- Development of general response actions (e.g., remediation, demolition, excavation, or containment) that may be taken to satisfy the RAOs
- Identification of radiologically impacted buildings
- Identification and evaluation of technology options applicable for each general response action based on the ability of each to achieve the RAOs, technical and administrative implementability, and cost
- Delineation of selected representative technologies and process options as they correspond to different general response actions to develop a range of remedial alternatives
- Detailed analysis of remedial alternatives based on seven of the nine evaluation criteria identified in the NCP
- Comparative analyses of alternatives for each of the evaluation criteria to identify the relative advantages and disadvantages of each alternative

The RAOs for the ROC associated with Parcel C were developed based on the media of concern, potential exposure pathways, and ARARs. The Addendum (TtEC 2008b) identified the Parcel C RAOs for radiologically impacted buildings, structures, and the storm drain and sanitary sewer system as:

- Prevent ingestion, dermal contact, or inhalation of ROC in concentrations that significantly exceed background concentrations

- Assure that the total effective dose from radiologically impacted sites to any member of the public did not exceed 25 mrem/y
- Ensure that the increased lifetime cancer risk did not exceed the NCP acceptable risk management range of 10^{-6} to 10^{-4} for future use scenarios

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Twelve alternatives were identified in the Addendum (TtEC 2008b) for soil, groundwater, and radiologically impacted sites. Each remedial alternative was evaluated in comparison to the two threshold and five balancing NCP evaluation criteria. A comparative analysis was then conducted to evaluate the relative performance of the five soil, four groundwater, and three radiologically impacted site remedial alternatives developed for Parcel C.

2.5.5 Record of Decision for Parcel C

The Parcel C ROD (DON 2010) presented the selected remedy for Parcel C. The remedy was selected in accordance with CERCLA, as amended by SARA, and to the extent practicable, the NCP. The DON and EPA jointly selected the remedy for Parcel C and concurrence was obtained from DTSC and the San Francisco Bay Regional Water Quality Control Board. The selected remedy for Parcel C addressed metals, polycyclic aromatic hydrocarbons (PAHs), other semivolatile organic compounds (SVOCs), volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs), and pesticides in soil as well as radionuclides in structures and in soil. The remedial action also addressed VOCs, PAHs, and other SVOCs found in groundwater in both the A- and B-aquifers, and metals and pesticides found in groundwater in the B-aquifer.

The remedy selected in the Parcel C ROD (DON 2010) consisted of:

- Excavation and off-site disposal, soil vapor extraction, durable covers, and institutional controls to address soil contamination
- Treatment of VOCs with zero-valent iron or a biological substrate, monitored natural attenuation, and institutional controls to address groundwater contamination
- Decontamination of buildings, removal of the storm drain and sanitary sewer systems, decontamination or removal of structures below Building 205, and excavation of soil to address radiologically impacted structures and soil

In addition, the Parcel C ROD (DON 2010) identified the radiological RAO and remediation goals. A complete discussion of the radiological RAO and remediation goals established in the Parcel C ROD is provided in Section 2.4 of this RCSR.

2.5.6 Parcel C Phase II Project Area Execution Plan

The final Parcel C Phase II Execution Plan (TtEC 2012c) was prepared and submitted to the DON in November 2012. This document provided information specific to the second phase of the Parcel C removal action activities not provided in the Radiological Management Plan (TtEC 2012a) including:

Internal Draft Parcel C Phase II RCSR_11-6-17 (RASO Comments)_sm_sra_sm (003).docx RMAC-0809-0012-0049-Draft Parcel C Phase II RCSR_11-6-17

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Draft Radiological Construction Summary Report

Parcel C Phase II
Hunters Point Naval Shipyard
DCN: RMAC-0809-0012-0049
CTO No. 0012

- Project schedule and plan organization
- Task-specific plan development for Ship Berths 1, 2, 3, 4, and 5 and preparing the FSS report
- Work implementation for storm drain and sanitary sewer systems removal action activities in Work Areas 31, 33, 34, and 35 and SUPR preparation
- RSY operation and processing of radiologically impacted excavated materials
- Laboratory operations including procedures and quality control
- Environmental Protection Plan including stormwater management, dust control, spill/release prevention, response, and reporting, and waste management practices
- Traffic controls including revised site traffic routes
- Cultural resource controls and archaeological monitoring

In addition, six further documents specific to the Parcel C project area were developed and presented as attachments to the Parcel C Phase II Execution Plan. These documents included:

- Attachment 1 – SAP
- Attachment 2 – Project Contractor Quality Control Plan
- Attachment 3 – Radiation Protection Plan
- Attachment 4 – Basewide Dust Control Plan
- Attachment 5 – Stormwater Pollution Prevent Plan
- Attachment 6 – Waste Management Plan

The Execution Plan was prepared in accordance with the requirements specified in the HPNS Radiological Management Plan and associated Sewer Plan attachment (TtEC 2012a). TtEC's SAP, was designed to support the Parcel C Phase II storm drain and sanitary sewer systems removal action activities, RSY soil processing activities, and radiological work associated with impacted Ship Berths 1, 2, 3, 4, and 5. The excavated soil generated during the Parcel C Phase II project area storm drain and sanitary sewer systems removal action activities and processed in the RSYs is discussed in Section 3.1.2.2 of this RCSR.

The general storm drain and sanitary sewer systems removal action approach outlined in the Parcel C Phase II Execution Plan was to remove the overlying pavement, excavate the soil, remove the storm drain and sanitary sewer systems piping, and continue excavation to a minimum depth of 1 foot below the pipe. Soil generated during the excavation activities was transferred to the RSYs for radiological processing. Radiological screening and sampling for piping was to be performed following removal. Open storm drain or sanitary sewer lines left in place during the removal process were to be plugged to prevent water from entering or exiting the pipes. FSS activities

were to be performed on the exposed sidewalls and bottoms of the excavated trench surfaces. After the results of these activities were evaluated, identified radiological contamination was removed. Concurrence would be obtained from the RASO-DON prior to backfilling the trenches and restoring the Parcel C Phase II project area.

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2.5.7 Parcel C Design Plan

The final "Design Plan, Parcel C Phase II" (Design Plan) (TtEC 2012d) was prepared for the DON and submitted to the regulatory agencies and other interested parties in November 2012. The Design Plan for Parcel C Phase II identified the storm drain and sanitary sewer systems pipelines and manholes to be removed during the second phase of the Parcel C project area time-critical removal action and provided construction procedures to accomplish these work activities.

The Design Plan (TtEC 2012d) provided information regarding the storm drain and sanitary sewer systems pipe size, flow direction, material type, and length. Detailed design drawings, HPNS construction specifications, and descriptions of the fieldwork procedures and methods applicable to the storm drain and sanitary sewer systems removal action activities were included in the Design Plan. The detailed design drawings were based on 1995 engineering drawings provided by the DON. Existing topographic data were obtained from the HPS Base Map (44 sheets) dated November 1, 1993 (Gahagan and Brian 1993). In addition, the Design Plan provided procedures for fieldwork implementation including:

- Permits and notifications
- Environmental resources, geophysical, and topographic surveys
- Vegetation removal
- Excavation and system removal
- Stormwater, sediment, and erosion control
- Radiological surveys and sampling
- FSSs
- Trench backfill
- Site restoration
- Decontamination and free release surveys
- Waste classification, storage, and disposal
- Demobilization

The Design Plan (TtEC 2012d) included the HPNS Basewide Construction Specifications (TtEC 2012e) and HPNS Backfill Review and Acceptance Procedure (TtEC 2006b). The HPNS Backfill Review and Acceptance Procedure is presented in Appendix B.

2.5.8 Survey Unit Project Reports Abstract for Naturally Occurring Radioactive Material

TtEC prepared the “Final Survey Unit Project Reports Abstract for Parcel C Sanitary Sewer and Storm Drain Removal Containing Naturally Occurring Radioactive Material (NORM) Fill Material Conducted after March 1, 2013” (NORM Abstract) (TtEC 2017). The purpose of the NORM Abstract was to summarize the scope, approach, and radiological surveys used during removal of the Parcel C storm drain and sanitary sewer systems containing NORM fill material conducted after March 1, 2013. This information and release criteria presented in the NORM Abstract was applicable to 10 Parcel C Phase II project area trench survey units as discussed in the appropriate sections of this RCSR.

Geological and radiologic analysis of soil types in Parcel C indicated that large quantities of NORM fill material were used to construct road base and surround conduit lines. Numerous storm drain and sanitary sewer systems trenches in Parcel C contained significant quantities of this material. This NORM fill material was characterized by its physical sandy brown characteristic as well as Ra-226 and thorium-232 (Th-232) concentrations above the typical concentrations in the soil from the reference area. Because this material naturally contained elevated concentrations of Ra-226 and Th-232 when compared to materials in the reference area used for SUPRs, an appropriate background area within Parcel C was necessary to avoid the unnecessary disposal of NORM fill material as LLRW. A complete description of the NORM fill material was provided in Appendix A to the NORM Abstract (Appendix A).

The NORM Abstract (Appendix A) provided a history of the storm drain and sanitary sewer systems at HPNS and documentation of the site’s operational history. The NORM Abstract also presented detailed discussions and common information related to storm drain and sanitary sewer systems removal actions in Parcel C including:

- Release limits
- ALARA process
- ROC and associated release criteria
- Investigation levels for gamma scan surveys
- FSS objectives, design, and methodology
- RSY processing of excavated soil
- Imported fill sources, screening, and analytical results
- Reference area and additional radioanalytical data
- Sample collection methodologies, preparation, and laboratory analyses including gamma spectroscopy analytical flags and total strontium/Sr-90 analysis
- Uncertainty analysis

- Data assessment (verification, validation, and evaluation)
- Statistical tests including decision errors and use of the Wilcoxon Rank-sum Test
- Dose modeling
- Recommendation of final unrestricted release

The release criteria for storm drain and sanitary sewer systems soil ROC, as presented in the NORM Abstract, are reproduced as Table 2-4 in this RCSR and include residual doses for both outdoor workers and residents. The NORM Abstract referenced in this RCSR is provided in Appendix A.

2.5.9 Survey Unit Project Reports

The radiological details of the storm drain and sanitary sewer systems removal action work activities completed were provided in the final versions of the individual SUPR prepared for each of the designated trench survey units within the Parcel C Phase II project area. The objective of each SUPR was to demonstrate that identified residual radioactivity levels within the excavated trench (exposed sidewalls and bottoms) and within the material used as backfill met the release criteria. The release criteria for trench survey units are provided in Tables 2-1 and 2-3 and the remediation goals are provided in Table 2-2. The release criteria for trench survey units containing NORM fill material are provided in Table 2-4. Fieldwork and construction activities were briefly summarized in each SUPR; however, detailed information related to the fieldwork performed is presented in this RCSR.

The individual SUPRs prepared for the trench survey units associated with the Parcel C Phase II project area presented radiological details and summarized the scope, approach, and survey results from the removal action activities. Each SUPR presented relevant discussions and pertinent information including:

- FSS activities performed for the trench survey unit and selected backfill materials
- Radionuclide specific release criteria
- On-site screening laboratory analytical results and off-site laboratory definitive data analytical results
- Dose modeling with input parameters applying the default residential farmer scenario of 12 hours per day indoors and 6 hours per day outdoors occupancy and using the larger of the method detection limit (MDL) or reported activity
- Dose and risk modeling results
- The ALARA process, including identification and review of potential radiological impacts as well as discussions related to qualitative and quantitative ALARA analyses
- Recommendation for final unrestricted radiological release

Each of the Parcel C Phase II project area SUPRs was previously provided to the EPA, the DSTC, and the Department of Public Health, Environmental Management Branch (CDPH), who submitted comments that were addressed in the final SUPRs. A copy of each final Parcel C Phase II project area SUPR is provided in Appendix C (Work Area 31), Appendix D (Work Area 33), Appendix E (Work Area 34), and Appendix F (Work Area 35).

2.5.10 Ship Berths 1, 2, 3, 4, and 5 Final Status Survey Report

The radiological details of the survey and FSS work activities completed for Ship Berths 1, 2, 3, 4, and 5 within the Parcel C Phase II project area removal action were provided in the final version of the FSS report. The objective of the FSS report was to demonstrate that identified residual ROC concentrations associated with the structure were less than the predetermined release criteria (Table 2-1) and remediation goals (Table 2-2) for the ROC. The FSS report provided the following:

- Site description
- Historical site assessments
- Release criteria and investigation levels
- Survey design
- Field activities
- Survey instrumentation
- Detection sensitivity – static and scan minimum detectable concentrations
- Data interpretation
- Review of data quality objectives
- Analysis and results
- Dose modeling
- ALARA process
- Conclusion and recommendation

The DON recommended the Ship Berths 1, 2, 3, 4, and 5 to the regulatory agencies for unrestricted radiological release based on the information presented in the FSS report and the residual dose and risk modeling results. A summary of the FSS activities performed for Ship Berths 1, 2, 3, 4, and 5 is presented in Section 8.0. The final FSS report for Ship Berths 1, 2, 3, 4, and 5 is provided in Appendix G.

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3.0 PARCEL C PHASE II PROJECT AREA OVERVIEW

This section is divided into four main components that provide an overview of the radiological activities performed for the Parcel C Phase II project area during the time-critical removal action. The purpose of this section is to eliminate redundancy in the remaining sections of this RCSR and to provide an overview of the radiological activities completed during the Parcel C Phase II project area removal action. The first component discusses those elements common to each of the storm drain and sanitary sewer trench survey units, and provides an overview of the removal action activities. The second component describes and summarizes the typical FSS activities performed for Ship Berths 1, 2, 3, 4, and 5. The third component discusses the results of the archaeological monitoring activities performed during the second phase of the Parcel C removal action. The final component briefly summarizes the IR Program Sites located within the Parcel C Phase II project area and related chemical laboratory analytical results. The tables and figures introduced in each component of this section will be referenced throughout the remaining sections of this RCSR.

The radiological work performed in the Parcel C project area was conducted under TtEC's United States NRC Service Provider Radioactive Material License. In accordance with NCP requirements, the ARARs for the work performed were presented in the AM (DON 2006) and the Parcel C ROD (DON 2010). The radiological release criteria for HPNS, as identified in the AM, are provided in Table 2-1. The Parcel C ROD established radiological remediation goals are provided in Table 2-2. The release criteria specifically for the storm drain and sanitary sewer systems removal action, as presented in the SUPR Abstract (Appendix A), are provided in Table 2-3. The NORM Abstract (Appendix A) specified the release criteria for those trench survey units containing documented high concentrations of NORM fill material. These release criteria are specified in Table 2-4.

Soil and sediment samples collected during the Parcel C Phase II removal action were analyzed by the both the on-site and off-site Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP) accredited laboratories in accordance with the Parcel C Phase II Execution Plan and SAP (TtEC 2012c). Throughout this RCSR, the term "laboratory" refers collectively to both the on-site and off-site laboratories and their respective functions unless otherwise specified.

3.1 STORM DRAIN AND SANITARY SEWER REMOVAL ACTION OVERVIEW

The Parcel C Phase II project area storm drain and sanitary sewer systems removal action fieldwork was initiated in October 2012 and continued through September 2014. During the Parcel C Phase II time-critical removal action, a total of 28 trench survey units were designated as follows:

- Work Area 31
 - Trench Survey Unit 321 (TU321)
 - Trench Survey Unit 322 (TU322)
 - Trench Survey Unit 328 (TU328)
 - Trench Survey Unit 332 (TU332)
 - Trench Survey Unit 339 (TU339)
- Work Area 33
 - Trench Survey Unit 315 (TU315)
 - Trench Survey Unit 316 (TU316)
 - Trench Survey Unit 317 (TU317)
 - Trench Survey Unit 318 (TU318)
 - Trench Survey Unit 319 (TU319)
 - Trench Survey Unit 320 (TU320)
 - Trench Survey Unit 329 (TU329)
 - Trench Survey Unit 330 (TU330)
 - Trench Survey Unit 331 (TU331)
 - Trench Survey Unit 338 (TU338)
- Work Area 34
 - Trench Survey Unit 323 (TU323)
 - Trench Survey Unit 324 (TU324)
 - Trench Survey Unit 325 (TU325)
 - Trench Survey Unit 326 (TU326)
 - Trench Survey Unit 327 (TU327)
 - Trench Survey Unit 336 (TU336)
 - Trench Survey Unit 337 (TU337)
- Work Area 35
 - Trench Survey Unit 312 (TU312)
 - Trench Survey Unit 313 (TU313)
 - Trench Survey Unit 314 (TU314)
 - Trench Survey Unit 333 (TU333)

- Trench Survey Unit 334 (TU334)
- Trench Survey Unit 335 (TU335)

Detailed discussions of each of the Parcel C Phase II project area trench survey units are provided in Sections 4.0 (Work Area 31) through 7.0 (Work Area 35) of this RCSR and the individual SUPRs are provided in Appendices C (Work Area 31) through Appendix F (Work Area 35). Figure 1-3 depicts the boundaries of each Work Area within the context of Parcel C. The individual storm drain and sanitary sewer trench survey units are depicted on Figure 3-1. Table 3-1 summarizes the activities performed for each trench survey unit within the Parcel C Phase II project area to support the recommendation for radiological release including associated trench segment identification numbers, size, and pertinent data related to samples collected, contamination identified, remediation performed, and dose modeling results.

3.1.1 Pre-Excavation Field Activities

Pre-excavation field activities for the Parcel C Phase II project area removal action were initiated on October 29, 2012. During these activities, temporary fencing was installed or reconfigured, dust controls and air monitoring were implemented, and traffic was controlled and rerouted in accordance with the Parcel C Phase II Execution Plan (TtEC 2012c) prior to initiating excavation activities.

Wind socks were installed to determine the prevailing wind direction and ensure proper placement of the air monitoring equipment on a daily basis. Measurements were collected for various contaminants including airborne asbestos, particulates, lead, and magnesium. Radiological air monitors also were installed upwind and downwind of the excavation activities. No radiological exceedances were identified during the Parcel C Phase II project area field activities. The air monitoring results were uploaded to the DON web site at <http://www.bracpmo.navy.mil/basepage.aspx?baseid=45&state=&name=HPNS>.

In November 2013, previously installed stormwater system swales were reconfigured in Work Area 35 in preparation for the upcoming asphalt removal activities and overhead electrical lines and supporting power poles were de-energized and removed in Work Area 34. Asphalt and concrete removal was initiated in Work Area 35 in November 2012 prior to beginning excavation activities. The majority of these materials were not located within radiologically impacted areas. The asphalt and concrete from these areas was transferred to stockpiles pending recycling activities.

3.1.2 Storm Drain and Sanitary Sewer Systems Excavation Activities

Excavation of the Parcel C Phase II project area storm drain and sanitary sewer systems was initiated on November 19, 2012 in Work Area 35, and the last truckload of soil was excavated on October 10, 2013 in Work Area 31. In total, 11,930 linear feet of storm drain and sanitary sewer

systems trenches (inclusive of soil, pipes, and manholes) were excavated during the Parcel C Phase II removal action. At the completion of excavation, the total area of the exposed trench surfaces (sidewalls and bottoms) was 22,067 m². Table 3-1 summarizes the radiological survey activities performed for the Parcel C Phase II project area storm drain and sanitary sewer systems during the time-critical removal action.

A total of 288 storm drain and sanitary sewer systems trench segments were identified in the Parcel C Phase II project area during the time-critical removal action. The piping associated with the Parcel C Phase II project area consisted of 2-inch-diameter to 30-inch-diameter CIP, PVC, RCP, steel, UCP, and VCP located at depths ranging from 1 foot to 13 feet below ground surface (bgs). At the completion of the storm drain and sanitary sewer systems removal action activities, a total of 28 trench survey units had been designated in Work Areas 31, 33, 34, and 35. The excavated trench survey unit depths ranged between 1 foot and 14 feet bgs. Table 3-2 identifies each Parcel C Phase II project area trench survey unit designated during the removal action, the associated trench segments, type of trench segment (storm or sanitary), pipe material and diameter, and minimum and maximum pipe depths.

3.1.2.1 Soil Excavation

In accordance with the Execution Plan (TtEC 2012c) and the Radiological Management Plan (TtEC 2012a), the soils overlying the storm drain and sanitary sewer pipes and approximately 1 foot of soil surrounding each pipe and manhole were excavated and transferred by truck to RSY3 or RSY4 for radiological processing. During the Parcel C Phase II project area storm drain and sanitary sewer systems removal action, a total of 2,502 truckloads (approximately 30,024 cubic yards) of soil were excavated and transferred to RSY3 or RSY4. The excavated soil generated during removal of the storm drain and sanitary sewer systems often included small sections of crumbled pipe and crushed manhole pieces that were radiologically processed along with the surrounding soil. The activities performed during radiological processing of the excavated soil in the RSYs are described in Section 3.1.2.2. Table 3-3 summarizes each truckload of excavated soil generated during the storm drain and sanitary sewer systems removal action activities, indicates the associated screening pad in the RSYs, and identifies the unique excavated soil survey unit number assigned to the soil placed on the screening pad for tracking radiological processing activities.

3.1.2.2 Radiological Screening Yard Processing of Excavated Soils

Soil generated during excavation of the Parcel C Phase II project area storm drain and sanitary sewer systems was transported to RSY3 or RSY4 and placed on screening pads specifically constructed for radiological survey activities. Each truckload of soil generated during excavation of the Parcel C Phase II project area storm drain and sanitary sewer systems was placed on specific screening pads designated by RSY operations staff. Once a screening pad reached capacity, the

excavated material was spread in lifts that did not exceed a thickness of 6 inches ~~or~~ and 1,000 m² in area. The excavated soil on the screening pads was allowed to dry prior to initiating the radiological processing activities.

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Radiological processing activities were initiated once the soil on the screening pads was prepared. Radiological surface surveys for each screening pad of excavated soil consisted of a high-density gamma scan performed with the use of gamma scintillation detectors supported by GPS equipment. Areas of soil placed on the screening pads that showed the potential presence of radiation levels greater than the established investigation limits were further evaluated, and investigative soil samples were collected, as appropriate. A discussion of the various towed array systems used for radiological surface scanning was provided in the SUPR Abstract (Appendix A). This process resulted in a 100 percent scan of the excavated soil placed on each screening pad. Radioactive materials identified during the scanning activities were collected, segregated, and stored in appropriate containers for subsequent disposal by the DON radiological waste contractor. The resulting gamma scan data for each excavated soil survey unit used as backfill material were presented in the individual trench survey unit SUPRs provided in Appendices C through F.

During radiological processing in the RSYs, a minimum of 18 systematic soil samples were collected from each Parcel C Phase II excavated soil survey unit placed on a screening pad and analyzed by the laboratory using gamma spectroscopy. Sample collection locations were based on a random start point using the most current version of VSP software (PNL 2007). Soil in the vicinity of any sample analytical result exceeding a radionuclide-specific release criterion was remediated. The release criteria are identified in Tables 2-1, 2-3, and 2-4, and the remediation goals are presented in Table 2-2.

Radiological contamination identified by the laboratory analytical results was remediated iteratively until the verification soil samples analyzed after each remediation event showed results less than the radionuclide-specific release criterion. Following the collection and analysis of the final 18 FSS soil samples and with the concurrence of the ~~RASO~~~~DON~~, each excavated soil survey unit was removed from the screening pad and transferred to the stockpile outside of the RSYs pending receipt of the Sr-90 laboratory analytical results. Once the Sr-90 laboratory analytical results were evaluated against the release criterion (Tables 2-1, 2-3, and 2-4), a data package was prepared for the ~~RASO's~~~~DON's~~ review that included all of the survey data and analytical results generated during the radiological processing activities for each excavated soil survey unit. The ~~RASO~~~~DON~~ then concurred with whether or not each excavated soil survey unit was acceptable for use as backfill material. Only those excavated soil survey units that received concurrence from the ~~RASO~~~~DON~~ and were not chemically contaminated based on IR Program site analytical results were used as backfill materials in the Parcel C Phase II project area trench survey units. Table 3-4 summarizes the radiological processing activities performed in the RSYs for the excavated storm drain and sanitary sewer systems soils generated during the Parcel C Phase II project area removal

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action and includes the unique excavated soil survey unit number, assigned RSY screening pad, associated IR Program site (if applicable), date on which the final gamma scan was performed, number of soil samples collected, identified ROC and analytical results when contamination was present, the estimated volume of soil remediated (if any), and the final disposition of each excavated soil survey unit.

In total, 3,099 soil samples were collected from the Parcel C Phase II project area storm drain and sanitary sewer systems excavated soil survey units radiologically processed in the RSYs during the removal action. These soil samples were analyzed by gamma spectroscopy in the on-site laboratory including 10 percent for quality assurance verification and 10 percent sent to the off-site laboratory for Sr-90 analysis. Based on the laboratory analytical results, approximately 1,092 cubic yards of soil that exceeded the radiological release criteria was remediated from the Parcel C Phase II project area excavated soil survey units processed in the RSYs. The remediated soil was placed in low-level radioactive waste (LLRW) bins for disposal by the DON radiological waste contractor. ROC concentrations greater than the release criteria for excavated soil processed in the RSYs were limited to Ra-226 ranging from 1.486 picocuries per gram (pCi/g) to 2.250 pCi/g and Sr-90 at 0.361 pCi/g.. None of the Parcel C Phase II project area excavated soil survey units processed in the RSYs identified the presence of Cs-137 contamination.

At the conclusion of the Parcel C Phase II project area removal action, a total of 105 screening pads containing soil generated during excavation of the storm drain and sanitary sewer systems were processed in the RSYs (Table 3-4). None of the final 18 systematic FSS soil sample analytical results collected from the excavated soil processed on the screening pads in the RSYs identified the presence of residual ROC concentrations above the release criteria. The laboratory analytical results for the excavated soil survey units used as backfill material in the Parcel C Phase II project area trench survey units were presented in the individual SUPRs provided in Appendices C through F.

A total of 45 radiologically processed and released excavated soil survey units were backfilled into appropriate Parcel C Phase II project area trenches with the concurrence of the DON. One entire excavated soil survey unit (ES-779) was placed in LLRW bins for off-site disposal by the DON radiological waste contractor. A total of 59 radiologically processed and released excavated soil survey units derived from Parcel C Phase II project area IR Program sites or displayed odor or staining were transferred off-site by the DON non-LLRW contractor for disposal at a CERCLA landfill. The IR Program site chemical analytical results and identification of the elevated chemicals of concern are discussed in Section 3.4

3.1.2.3 Devices

On March 28, 2013, a potential radiological device above a phone located adjacent to Building 204 was identified during a pre-site activity walk through. Characterization gamma scans

confirmed the presence of a radium marker device. The device was removed, labeled as #12-WA35-B204-001, and transferred to the Building 258 radioactive materials area until transfer to the DON LLRW contractor on March 28, 2016. Copy of the transfer documentation is provided in Appendix H.

3.1.3 Storm Drain and Sanitary Sewer Systems Piping

Storm drain and sanitary sewer systems pipes and manholes (collectively called piping) were removed from the Parcel C Phase II project area during excavation of the trenches. The majority of the piping was crushed or disintegrated during removal and the debris was transferred along with the surrounding excavated soil to the RSYs for radiological processing. Storm drain and sanitary sewer systems piping that was not crushed or crumbled during excavation activities was staged on plastic pending final disposition. Tables 3-5 and 3-6 identify the final disposition of the storm drain and sanitary sewer systems piping excavated from Work Areas 31, 33, 34, and 35 during the Parcel C Phase II project area removal action.

3.1.3.1 Pipe and Manhole Sediments

A sufficient volume of sediment for sample collection and analysis was collected from 21 sections of pipe and 13 manholes during the Parcel C Phase II project area removal action (Table 3-5). These 34 sediment samples were submitted to the laboratory for analysis by gamma spectroscopy. The collected data were reviewed by the RSO to determine whether the release criteria had been exceeded. The release criteria are identified in Tables 2-1, 2-3, and 2-4, and the remediation goals are presented in Table 2-2.

Based on the sediment sample laboratory analytical results, 15 pipe and 9 manhole sediment samples did not identify the presence of radiological contamination above the release criteria. However, the analytical results identified the presence of Cs-137 contamination in sediment collected from five sections of pipe and one manhole and Ra-226 contamination in sediment collected from one section of pipe and three manholes associated with the Parcel C Phase II project area storm drain and sanitary sewer systems. The highest Cs-137 sediment concentration was identified in a pipe section excavated from trench segment 12-C34-28-8L (TU336) at 0.3763 pCi/g and the highest Ra-226 sediment concentration was identified in a pipe section excavated from trench segment 12-253-28-8D (TU337) at 5.94 pCi/g. No Sr-90 concentrations above the radionuclide-specific release criterion were identified in the sediment sample laboratory analytical results.

The Parcel C Phase II project area pipe sections and materials forming the manholes containing Cs-137 or Ra-226 sediment contamination were placed in LLRW bins during the removal action activities. The debris was shipped off-site to either the U.S. Ecology facility in Idaho or the Energy Solutions facility in Clive, Utah by the DON radiological waste contractor as LLRW. Table 3-5 summarizes pertinent information related to the Parcel C Phase II project area pipe and manhole

sediment sample identification numbers, analytical results, and disposition of the associated piping. The sediment sample analytical reports are provided in Appendix I.

3.1.3.2 Piping Radiological Surveys

During the Parcel C Phase II project area removal action, radiological survey activities were performed for 398 sections of pipe and 69 manholes (Table 3-6). These radiological surveys consisted of a 100 percent surface scan on each excavated pipe section and materials forming each manhole. In addition, two static measurements were recorded, and two swipe samples were collected and submitted to the laboratory for analysis. The collected data were reviewed by the RSO to determine whether investigative levels had been exceeded. None of the results identified the presence of radioactivity concentrations exceeding the release criteria. A total of 21 sections of pipe were not surveyed during the Parcel C Phase II project area removal action either due to the narrow diameter of the pipe or because of the composition of the pipe section. The pipe sections that could not be surveyed were placed in LLRW bins for off-site disposal by the DON radiological waste contractor. In addition, the brick materials forming manhole MH998 were not surveyed due to the presence of firebrick. The brick materials forming manhole MH998 were placed in LLRW bin GFLU001117T1 on March 13, 2013. The release criteria are identified in Tables 2-1, 2-3, and 2-4, and the remediation goals are presented in Table 2-2. Table 3-6 identifies the piping surveyed, provides the associated radiological survey report number, and presents final disposition. The radiological survey reports are provided in Appendix J.

3.1.3.3 Piping Remaining in Place

Small sections of piping were left in place following the completion of the Parcel C Phase II project area removal action due to obstructions such as active utility lines or to protect the structural integrity of stormwater outfalls. In addition, piping was left in place that will be addressed during future Parcel C removal actions and radiological survey activities to be performed for impacted buildings and structures. Table 3-7 identifies the piping remaining in place within the Parcel C Phase II project area following completion of the removal action and includes the associated trench survey unit, trench segment or component, component type, and linear feet of pipe removed or remaining in place. Further details related to specific piping left in place are provided in the Work Area 31 (Section 4.0) through Work Area 35 (Section 7.0) sections of this RCSR.

3.1.4 Storm Drain and Sanitary Sewer Systems Trenches

During the Parcel C Phase II project area time-critical removal action, a total of 28 trench survey units were designated in Work Areas 31, 33, 34, and 35. Figure 3-1 depicts the locations of these trench survey units within the Parcel C Phase II project area. No trench survey unit exceeded 1,000 m² in exposed surface area (sidewalls and bottom). Detailed discussions for each of the Parcel C Phase II project area trench survey units are provided in Section 4.0 (Work Area 31), Section 5.0 (Work Area 33), Section 6.0 (Work Area 34), and Section 7.0 (Work Area 35). Table

3-1 summarizes the radiological activities performed for each trench survey unit along with the Work Area location, associated trench segments, area and length, and relevant data related to number of samples collected, contamination identified (if any), contaminant concentration (if any), volume of soil remediated, and dose and risk modeling results. The SUPRs for each of the 28 Parcel C Phase II project area trench survey units are provided in Appendix C (Work Area 31) through Appendix F (Work Area 35).

3.1.4.1 Trench Survey Unit Activities

Following completion of the excavation and piping removal, radiological survey activities were performed for each trench survey unit to determine whether residual ROC concentrations exceeded the release criteria. The release criteria are identified in Tables 2-1, 2-3, and 2-4, the remediation goals are presented in Table 2-2. Typically, gamma scan surveys were performed over 100 percent of the exposed trench surfaces (sidewalls and bottoms) and static measurements were collected from the systematic and biased sampling locations, as appropriate. A minimum of 18 systematic sample locations were generated using VSP software, based on a random start point and a triangular grid that did not exceed 1,000 m² over the exposed trench surface (VSP 2007). Sample collection points were placed in the field using approved land surveying technologies and identified with the GPS.

A minimum of 18 systematic soil samples were collected from the exposed sidewalls and bottoms of each of the designated 28 Parcel C Phase II project area trench survey units to determine whether radionuclide contamination was present above the release criteria. The systematic soil samples were submitted under chain-of-custody to the laboratory for analysis by gamma spectroscopy. In addition, investigative samples were collected and analyzed, as needed, based on the results of trench survey activities and/or piping sediment sample analytical results. Soil samples were submitted to the on-site laboratory for analysis by gamma spectroscopy including 10 percent for quality assurance verification with 10 percent analyzed for Sr-90 by an off-site DoD ELAP-accredited laboratory.

During the Parcel C Phase II project area removal action, a total of 761 soil samples were collected from the sidewalls and bottoms of the 28 designated trench survey units and analyzed by the laboratory. Of these 761 soil samples, a total of 257 were investigative and 504 were the final systematic FSS soil samples. Throughout this RCSR, “investigative” trench survey unit soil samples refers to any systematic, characterization, investigation, or verification soil sample that was not one of the final 18 FSS soil samples. As indicated in Table 3-1, Ra-226 contamination identified in the investigative soil sample analytical results ranged from 2.096 pCi/g in TU313 (Work Area 35) to 2.898 pCi/g in TU316 (Work Area 33). None of the investigative soil samples identified the presence of Cs-137 or Sr-90 concentrations above the radionuclide-specific release criterion.

3.1.4.2 Trench Survey Unit Remediation Activities

Soil in the vicinity of samples showing the presence of radioactivity concentrations above the release criteria or NORM Abstract release criteria was remediated during the Parcel C Phase II project area removal action. Approximately 163.25 cubic yards of soil was remediated from TU313, TU316, TU318, TU333, TU334, and TU335 (Table 3-8). The contaminated soils remediated from these trench survey units were placed in LLRW bins pending off-site disposal by the DON radiological waste contractor. The LLRW bins were transported off-site to either the U.S. Ecology facility in Idaho or the Energy Solutions facility in Clive, Utah. Table 3-8 identifies each Parcel C Phase II project area trench survey unit, the dates remediation was performed, estimated volume of soil remediated, and the final disposition of the contaminated soil.

3.1.4.3 Trench Survey Unit Final Status Survey Activities

The objective of the storm drain and sanitary sewer systems FSS activities was to demonstrate that identified residual radioactivity levels inside the excavated trench (exposed sidewalls and bottoms) and within the materials used as backfill for each trench met the release criteria. The FSS activities were performed in accordance with the Execution Plan (TtEC 2012c) and the Radiological Management Plan (TtEC 2012a). The “Multi-Agency Radiation Survey and Site Investigation Manual” (MARSSIM) (DoD et al. 2000), the “Nonparametric Statistical Methodology for the Design and Analysis of the Final Status Decommissioning Survey Guide” (Survey Guide) (NUREG-1505; NRC 1998), and the “Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions Guide” (Field Conditions Guide) (NRC 1997) were used as guidance in designing the FSSs. In general, FSSs for every excavated trench survey unit included a 100 percent surface scan and systematic and biased static or direct measurements. Static surface radiation measurements were collected at each systematic sample location prior to the collection of the soil sample to identify the potential presence of gross contamination.

Systematic soil samples were collected from the sidewalls and bottom of each excavated trench survey unit after establishing a grid that did not exceed 1,000 m² over the exposed trench surface. A minimum of 18 systematic and discrete soil samples were collected from each trench survey unit and submitted to the laboratory for analysis by gamma spectroscopy. In addition, 10 percent of the samples were submitted for quality assurance with 10 percent of the samples analyzed for Sr-90.

During the Parcel C Phase II project area removal action FSS activities, a total of 504 systematic trench soil samples were collected and analyzed by the on-site laboratory. The collected data were reviewed by the RSO to determine whether investigative levels had been exceeded. The FSS samples were then submitted to either the on-site or off-site DoD ELAP-approved laboratory for definitive analysis. None of the 504 FSS soil sample analytical results indicated the presence of

residual ROC concentrations above the release criteria. The FSS laboratory analytical results were then used for dose and risk modeling as discussed in Section 3.1.5. The laboratory analytical results for the trench survey FSS soil samples were presented in each of the 28 SUPRs provided in Appendix C (Work Area 31) through Appendix F (Work Area 35). Table 3-1 summarizes the Parcel C Phase II project area activities performed, including the results of the dose and risk modeling efforts, to support the recommended radiological release of the 28 trench survey units.

3.1.5 Trench Survey Unit Dose and Risk Modeling

For dose and risk modeling efforts, storm drain and sanitary sewer systems trench survey units were composed of two different types: 1) trenches and 2) backfill material. Dose and risk modeling was performed for each of the 28 trench survey units designated in the Parcel C Phase II project area using the default residential farmer scenario of 12 hours per day indoors and 6 hours per day outdoors occupancy as provided in the most current version of RESRAD software at the time of the modeling exercise (Yu et. al. 2001). The backfill material and the trenches were modeled separately with input parameters using the larger of the MDL or reported activity concentrations. The release criteria was then modeled using RESRAD Version 6.4 based on the 25 mrem/y total effective dose equivalent or were otherwise risk-based (Yu et. al. 2001). The release criteria are identified in Tables 2-1, 2-3, and 2-4. The remediation goals are presented in Table 2-2.

The results of the modeling efforts for each of the 28 designated trench survey units fell within the acceptable NCP risk management range of 10^{-6} to 10^{-4} , which supports radiological release. Based on the dose and risk modeling results, the highest net dose to workers or members of the public as a result of exposures to residual concentrations of ROC and their decay products in soil from the Parcel C Phase II project area trench survey units was identified in TU314 at 4.345 mrem/y with an excess lifetime cancer risk of 7.231×10^{-5} . The modeling efforts are discussed separately for each of the 28 trench survey units in this RCSR and a complete discussion of the dose and risk modeling results was presented in each SUPR provided in Appendices C (Work Area 31) through F (Work Area 35). Tables 2-1, 2-3, and 2-4 present the storm drain and sanitary sewer systems removal action release criteria including residual doses for both outdoor workers and residents. A summary of the dose and risk modeling results for each trench survey unit is provided in Table 3-1.

3.1.6 As Low As Reasonably Achievable Process for Trench Survey Units

ALARA is a philosophy of striving for excellence in the practice of health physics and is an important aspect of radiation-safety regulations. The application of ALARA includes the consideration of economic and social factors. The ALARA concept is founded in the professional judgment of radiation-safety managers and personnel and does not provide a numerical limit below which the ALARA concept is achieved.

Four steps were taken to implement the environmental ALARA policy for the Parcel C Phase II project area radiological activities including:

- Identification of Potential Radiological Impacts
- Review of Radiological Impacts
- Performance of Qualitative ALARA Analyses
- Performance of Quantitative ALARA Analyses

Radiological impacts to the environment, workers, and the public from field operations were assessed for compliance with ALARA principles. Results from survey activities, and air, soil, sediment, swipe, and water samples were used to assess the radiological impacts of Parcel C Phase II project area fieldwork. The radiological impacts were determined using nine methods: 1) several air monitoring stations located around the excavation site perimeter to measure radionuclide concentrations in the air, and the results of this monitoring are provided to the ~~RASO~~~~DON~~ on a monthly basis; 2) field monitoring and sampling to identify areas requiring additional remediation; 3) remediation of contaminated areas at or above the release criteria; 4) control of radiologically impacted areas and work sites; 5) frisking of personnel and examining equipment leaving a radiologically controlled area; 6) use of release criteria that equate to dose and risk; 7) review of historical radiological operations to allow complete investigation of all areas of radiological concern; 8) characterization of radiologically impacted sites to ensure complete removal of radioactive material above the release criteria; and 9) dosimetry worn by personnel to measure time-averaged doses from gamma radiation.

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Laboratory analyses were performed for 19 different isotopes to ensure that any possible radioactive contamination was identified. After each excavation was completed, the qualitative radiological impacts from operations were evaluated by performing a dose and risk assessment. The results of analyses and assessments are provided to the ~~RASO~~~~DON~~ and regulatory agencies for review.

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As described in the SUPR Abstract and the NORM Abstract (Appendix A), the environmental ALARA process was implemented for each of the 28 Parcel C Phase II project area trench survey units. The ALARA process was discussed in the individual SUPRs provided in Appendices C (Work Area 31) through F (Work Area 35) and the SUPR Abstract and NORM Abstract (Appendix A). ALARA analyses were performed based on recent estimates of dose to the public from HPNS operations. Based on qualitative ALARA analyses, excavation projects that could cause the potential dose to the public to exceed 1 millirem (individual) or 10 person-rem (collective) were subjected to quantitative ALARA analyses. To date, no operations performed by TtEC at HPNS have resulted in an individual dose to the public greater than 1 millirem or a collective dose greater than 10 person-rem. Qualitative ALARA analyses did not identify any gamma exposure rate measurements above the investigation levels, and none of the sample results identified ROC

concentrations above the release criteria. In addition, air monitoring results did not exceed 10 percent of the derived air concentration for members of the public and the processed personnel dosimetry badges did not identify a single dose above background levels.

3.1.7 Imported Fill

The removal action activities performed for the Parcel C Phase II project area necessitated the import of appropriate soil for use as backfill material:

- When an insufficient volume of radiologically released excavated soil survey units that had been processed in the RSYs were available for these activities
- To account for the void created by removing the storm drain and sanitary sewer systems piping
- To replace the soil volumes removed during remediation activities
- To provide appropriate materials for proper compaction and roadway stability

The DON directed TtEC to develop the “Hunters Point Shipyard Project Backfill Review and Acceptance Procedure HPO-Tt-0270” (Appendix B) to describe the procedural requirements necessary to ensure that imported fill was adequately reviewed and accepted prior to being brought to HPNS. In addition, soil being screened for potential backfill material was sampled in accordance with specific instructions identified in the SAP, Appendix A of the Execution Plan (TtEC 2012c). Potential imported fill that did not meet the review and acceptance criteria was not transported to HPNS. The laboratory analytical results and data evaluation for the imported fill used as backfill material are provided in Appendix K.

Imported fill was used as backfill material in the majority of the excavated trenches as either a supplement to the radiologically processed and released excavated soil survey units or as acceptable material for proper compaction and roadway stability. A complete discussion of the imported fill was provided in the SUPR Abstract and NORM Abstract (Appendix A) including soil radiological analytical results and acceptance criteria. The imported fill used as backfill in the Parcel C Phase II project area was designated as “Mills Peninsula Hospital” and “Jericho” soil. Table 3-1 identifies the specific backfill materials used in each trench survey unit associated with the Parcel C Phase II project area.

3.2 SHIP BERTHS 1, 2, 3, 4, AND 5 OVERVIEW

Ship Berths 1, 2, 3, 4, and 5 were identified as radiologically impacted in Volume II of the HRA (NAVSEA 2004) within the Parcel C Phase II project area. Figures 1-3 and 3-1 depict the Work Areas and impacted Ship Berths 1, 2, 3, 4, and 5 within the context of HPNS and Parcel C. The following sections provide an overview of the FSS activities performed for each of the radiologically impacted ship berths within the Parcel C Phase II project area.

3.2.1 Survey Design

The radiological surveys for impacted Ship Berths 1, 2, 3, 4, and 5 were planned in accordance with MARSSIM (NUREG-1575; DoD et al. 2000) with guidance for the design of the survey and its implementation provided by the A Nonparametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys (NUREG-1505; NRC 1998), and Minimum Detectable Concentrations With Typical Radiation Survey Instruments for Various Contaminants and Field Conditions (NUREG/CR-1507; NRC 1998). The surveys were performed in accordance with the task-specific plan prepared for Ship Berths 1, 2, 3, 4, and 5 and the requirements outlined in the Radiological Management Plan (TtEC 2012a).

The intent of each survey design was to collect sufficient data to support the development of an FSS in accordance with MARSSIM (NUREG-1575; DoD et al. 2000). To maintain the potential for the scoping survey to become an FSS, data were continuously analyzed and evaluated to determine the relationship between each survey unit and the reference (background) area. The objective of the surveys was to achieve radiological release for unrestricted use of Ship Berths 1, 2, 3, 4, and 5 by demonstrating that residual radioactivity levels met the radionuclide-specific release criterion for each associated ROC. These limits were documented in the AM (DON 2006) and ROD (DON 2010) and are reproduced in this RCSR as Tables 2-1 and 2-2, respectively.

3.2.2 Unrestricted Radiological Release Criteria

The EPA release limits for unrestricted use were applied in assessing the results of the survey activities for radiologically impacted Ship Berths 1, 2, 3, 4, and 5. Results were analyzed to determine whether residual ROC concentrations, distinguishable from background ROC concentrations, resulted in an excess lifetime cancer risk greater than the NCP acceptable risk management level of 10^{-6} to 10^{-4} , and if the residual ROC concentrations had been reduced to levels that were ALARA. This excess lifetime cancer risk range was considered more conservative than the NRC dose-based unrestricted release criterion of 25 mrem/y. This radiological release process ensured that residual radioactivity did not result in individuals being exposed to unacceptable levels of radiation or radioactive materials.

The radionuclide-specific release criteria, referred to as derived concentration guideline limits (DCGLs), used for the Parcel C Phase II project area FSS activities were equivalent to the ROC release criteria specified in the AM (DON 2006) and the remediation goals established in the ROD (DON 2010). The DCGLs were expressed in terms of activity concentrations and referred to average levels of radioactivity above background levels corresponding to a total effective dose equivalent of 12 mrem/y to a member of the critical group, as modeled in RESRAD (Yu et. al. 2001) or RESRAD-BUILD (Yu et. al. 2003). The parameter values used in RESRAD and RESRAD-BUILD were for a reasonably maximum exposed individual. The DCGLs corresponding to a dose of 12 mrem/y for structures and equipment surfaces were expressed in disintegrations per minute (dpm) per 100 square centimeters (cm^2) and open areas (soil) are

expressed in pCi/g. Typically, each radionuclide DCGL corresponded to the release criterion (e.g., regulatory limit in terms of dose or risk). However, in the presence of multiple radionuclides, the DCGLs were adjusted using the unity rule. Consequently, the unity rule and development of a gross activity DCGL for surface activity was used to adjust the individual radionuclide DCGLs. The formulas used to calculate the DCGLs were presented in the Radiological Management Plan (TtEC 2012a).

In the simplest case, the release criteria were applied directly to survey data to demonstrate compliance. This involved assessing the activity levels and comparing measured values to the appropriate release criterion.

3.2.3 Investigation Levels

Investigation levels are specific levels of radioactivity used to indicate whether additional investigation may be necessary and also serve as a quality control check. When determining an investigation level using a statistical-based parameter (e.g., standard deviation), the following may be considered:

- Survey objectives
- Underlying radionuclide distributions (e.g., normal, log normal, nonparametric)
- Data population descriptors (e.g., standard deviation, mean, median)
- Prior survey and historical information

When investigation levels were exceeded, the measurements were confirmed to ensure that the initial measurement/sample actually exceeded the specific investigation level. This involved collecting further measurements to confirm the initial result and quantify the area of elevated residual radioactivity, if appropriate.

The investigation level for alpha surveys was 2 or more alpha counts over a 4-second observation interval followed by 2 or more alpha counts over a 4-second observation interval. The investigation level for beta surveys was 900 dpm/100 cm², which is 90 percent of the Sr-90 release criterion as presented in Tables 2-1 and 2-2.

The potential alpha and beta removable surface contamination investigations were performed by collecting a swipe sample over those locations where static measurements were obtained to determine the fraction of removable activity present, relative to the total activity. These loose surface investigation levels were set at 20 percent of the values for total (fixed plus removable) activity.

The investigation level for gamma surveys was established at the reference area mean plus 3-sigma, where sigma is the standard deviation of the gamma readings in the reference area.

Because several instruments were used during survey activities, there were different investigation levels based on the individual instrument parameters. Currently, there are no established release criteria based on gamma radiation readings alone. Essentially, gamma surveys were performed as an added measure to identify areas of gross contamination that would be an immediate health and safety concern and to help detect any anomalies, such as gamma-emitting sources, that may not emit alpha or beta radiation.

3.2.4 Reference Areas

Certain radionuclides may occur at significant levels as part of background in the medium of interest such as the naturally occurring members of the uranium, thorium, and actinium series. As a result of nuclear weapons fallout, Cs-137 and other radionuclides were also present in background (Wallo et al. 1994). Establishing background concentrations that describe a distribution of measurement data is necessary to identify and evaluate contributions attributable to historical HPNS operations. Determining background levels for comparison with the conditions determined in specific survey units entails conducting surveys in one or more reference areas to define the radiological conditions of the site.

A site background reference area should have similar physical, chemical, geological, radiological, and biological characteristics as the survey unit being evaluated. Background reference areas are normally selected from areas that are not radiologically impacted, but are not limited to natural areas undisturbed by human activities. In some situations, a reference area may be associated with the survey unit being evaluated, but could not have been potentially contaminated by site activities. Reference areas provide a location for background measurements that were used for comparison with collected survey unit data. Ideally, the radioactivity present in a reference area would be the same as the radioactivity present in the survey unit had it never been contaminated.

For soil, the area between Building 526 and Berth 29 in Parcel D-1 was used as the reference area because its surroundings, vegetation, and overall topography are similar to those at Ship Berths 1, 2, 3, 4, and 5 Survey Units 2 through 9, and this area has no history of radiological use. The area between Building 526 and Berth 29 was determined to contain soils similar to those encountered in the Ship Berths 1, 2, 3, 4, and 5 soil survey units.

Twenty soil samples were collected systematically from the Parcel D-1 area for use as reference area measurements for the soil survey units. All 20 samples were initially analyzed for use as screening data by the on-site DoD ELAP-accredited laboratory (Curtis & Tompkins), and for use as final definitive data by Curtis & Tompkins or a DoD ELAP-accredited off-site laboratory (TestAmerica St. Louis) by gamma spectroscopy. These reference area samples provided a basis for net activity concentration. During the initial analysis for screening purposes at the on-site laboratory, the background activity for Ra-226 was determined to be 0.633 pCi/g, placing the

release criterion at 1.633 pCi/g. For final definitive data, the on-site laboratory background activity for Ra-226 was determined to be 0.365 pCi/g, placing the release criterion at 1.365 pCi/g.

Based on a geological analysis of the soil in Survey Unit 1, a more appropriate background reference area was collected in December 2013 from an unimpacted area to the southeast of Lockwood Avenue adjacent to Parcel C. Eighteen reference area soil samples were collected and analyzed at the on-site DoD ELAP-accredited laboratory. Final definitive analysis for Ra-226 was determined to be 1.057 pCi/g, placing the release criterion at 2.057 pCi/g for Ra-226.

Soil samples for Pu-239 and Sr-90 analysis were sent to the DoD ELAP-accredited off-site laboratory (TestAmerica St. Louis).

3.2.5 Survey Procedures

Survey procedures were performed in accordance with the SOPs approved for use at HPNS and the Radiological Management Plan (TtEC 2012a). Class 1 survey units for Ship Berths 1, 2, 3, 4, and 5 were comprised of concrete or soil. Each Class 1 survey unit was less than 800 m² in area. No Class 2 survey units were associated with Ship Berths 1, 2, 3, 4, and 5. Using a random start point in each survey unit, systematic data collection locations were laid out in a grid pattern using VSP software (PNL 2007).

Each Class 1 survey unit received 100 percent surface scan coverage using either a ~~RASO approved~~ drive-over array system or a Ludlum Model 2350-1 survey meter equipped with a Ludlum 44-10 2-inch by 2-inch sodium iodide (NaI) detector. Scanning activities were performed in each survey unit to identify elevated levels of radiation, relative to corresponding background levels from the selected reference area. Gamma scan readings were logged and those exceeding the investigation level were identified for additional surveys. In the event of remediation, areas were scanned during and after remediation to ensure the source of contamination was removed prior to collecting a post-remediation sample.

Alpha and beta (particulate) radiation scan surveys were performed over concrete surfaces in addition to gamma scans. The alpha and beta scans were performed using a Ludlum Model 2360 data logger equipped with a Ludlum Model 43-37-1 821-cm² gas-flow proportional detector. Alpha and beta scan data were evaluated to determine whether any readings exceeded the release criteria. Biased measurements were collected at any locations showing readings that exceeded the investigation level.

Following scanning and data evaluation, static measurements were logged at 27 systematic discrete systematic points in concrete survey units and 20 systematic locations in soil survey units using a triangular grid with a random start point. The static measurement locations were established using VSP software based on a random start point and a systematic grid pattern. Based on the gamma scan readings, a minimum of two biased static measurements and sample collection locations in

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the areas with most elevated gamma measurement were selected for the soil survey units. Static gamma measurements were collected at the specified systematic and biased locations in each survey unit using a Ludlum Model 2350-1 survey meter with a Ludlum 44-10 2-inch by 2-inch NaI detector. If a review of the data showed that the corresponding gamma spectroscopy analytical results did not exceed the release criteria, elevated static gamma measurements were likely the result of the relatively elevated concentration of naturally occurring radionuclides. Static alpha and beta measurements were collected from each of the systematic locations in concrete survey units using a Ludlum Model 2360 data logger equipped with a Ludlum Model 43-68, 126-cm² gas-flow proportional detector in addition to the gamma static measurements.

Swipe samples for concrete survey units were collected at each systematic and biased static location to assess the presence of alpha and beta radioactive contamination that was readily removable from a surface. The scan readings, static measurements, and swipe sample results were provided in the Ship Berths 1, 2, 3, 4, and 5 FSS report presented in Appendix G.

Swipe and soil samples were analyzed by the laboratories and the resulting data were assessed by the RSO to determine whether the objectives of the survey process were met. The assessment process consisted of four data phases:

1. Verification
2. Validation
3. Evaluation
4. Quality assessment

In addition, results from the off-site and on-site laboratory analyses were reviewed to ensure that the residual ROC concentrations for FSS samples was less than the release criteria. Detailed discussions of the RSO assessment process and the off-site and on-site laboratory data comparison were provided in the Ship Berths 1, 2, 3, 4, and 5 FSS report presented in Appendix G.

3.2.6 Sample Collection and Analysis

Samples for radiological analysis were collected in the field and were first processed through a colander apparatus to eliminate foreign objects and large debris. The sample was then sent to the on-site laboratory using the chain-of-custody (COC) procedure described in the Basewide Radiological Management Plan (TtEC 2012a). Each sample was verified to contain identical information on the sample container and the associated COC form when it was received at the laboratory.

Once the samples were received by the on-site laboratory, each sample was verified to contain less than 10 percent moisture content by weight. Samples with moisture content in excess of the 10 percent limit were dried in a laboratory oven. Once the moisture content was determined to be less than 10 percent, the sample was passed through consecutively smaller sieves to screen for any

foreign materials that may have been present. An aliquot of the remaining materials was then placed into the approved container for laboratory analysis.

All definitive gamma spectroscopy analyses were performed by the DoD ELAP-accredited laboratory Curtis & Tompkins. The on-site laboratory was used for gamma spectroscopy screening analysis to expedite turnaround times to guide investigation, characterization, and remediation activities. Once the FSS analytical results were determined to be below the release criteria at the on-site laboratory, the samples were submitted to Curtis & Tompkins for definitive analysis.

The on-site laboratory analyzed the screening samples directly for Ra-226 using the EPA 901.1 MOD method and calculating Ra-226 activity from the 3.6 percent abundant 186.2 keV gamma spectrum line. For definitive analysis, TestAmerica and Curtis & Tompkins quantified the Ra-226 concentration using the EPA 901.1 MOD method or Department of Energy Health and Safety Laboratory (HASL) 300 4.5.3.2 method. The Ra-226 results were calculated and reported from the 46.09 percent abundant 609.31 keV gamma spectrum line of Bi-214 after an in-growth period of greater than 21 days to allow the Bi-214 to approach secular equilibrium with Ra-226.

The DoD ELAP-accredited laboratory (TestAmerica St. Louis) determined total strontium and Sr-90 through chemical separation and total beta activity. For soils, the strontium is transferred from the soil into a liquid matrix prior to precipitation as insoluble carbonate. Interferences from calcium and other radionuclides are removed by one or more precipitations. Total strontium and Sr-90 were counted for beta particle activity. The results of total strontium analysis were reported in pCi/g.

In most cases, Sr-90 was analyzed for total strontium. If the total strontium result was less than the Sr-90 release criterion, this result was conservatively reported as the Sr-90 result. However, if the total strontium result exceeded the Sr-90 release criterion, the sample was further analyzed. Any sample exhibiting Cs-137 activity greater than the release criterion was also analyzed for total strontium/Sr-90. In addition, a minimum of 10 percent of samples was randomly chosen for Sr-90 analysis at the DoD ELAP-accredited laboratory.

Alpha-emitting radioisotopes spontaneously produce alpha particles (or helium-4 nuclei) at characteristic energies usually between about 3 and 6 MeV. Alpha particles are heavy charged particles. Because they are large and slow, alpha particles lose energy readily in materials. Any physical medium between the alpha emitting radionuclide and the active portion of the detector will absorb some of the alpha particle energy. These absorption characteristics, which manifest themselves both within the sample and with any materials, including air, between the sample and the active detector volume, cause a characteristic tailing in the alpha peak. Therefore, the samples were counted in a vacuum and the samples are prepared to be as thin as possible to avoid self-absorption.

The results of the Pu-239 analysis were reported in pCi/g. Any sample exhibiting Cs-137 and Sr-90 activity greater than the release criteria would have also been analyzed for Pu-239. In addition, a minimum of 10 percent of the final systematic samples were randomly chosen for Pu-239 analysis at the DoD ELAP-accredited laboratory.

3.2.7 Dose and Risk Modeling

Radionuclide-specific release criteria were obtained from the AM (DON 2006) and were then modeled using RESRAD Version 6.3 and RESRAD-BUILD Version 3.3 (previous versions) based on the 25 mrem/y total effective dose equivalent or were risk based; the final doses using the risk-based release criterion for HPNS were all less than this 25 mrem/y release criterion (Yu et. al. 2001, Yu et. al. 2003). Following discussions with the EPA and as a matter of policy at HPNS, the DON and the RASO ensured that the resulting excess lifetime cancer risk fell within the NCP acceptable risk management range of 10^{-6} to 10^{-4} prior to recommending a site or building for unrestricted release. This risk is more conservative than the NRC dose-based unrestricted release criterion of 25 mrem/y. In addition, lead-210 was modeled at secular equilibrium with Ra-226 activity to ensure that all Ra-226 decay products were included in the dose and risk calculations.

To provide the best possible estimation of dose and risk for the residual activity at Ship Berths 1, 2, 3, 4, and 5, the DON used the most current version of RESRAD or RESRAD-BUILD for calculations (Yu et. al. 2001, Yu et. al. 2003).

For Ship Berths 1, 2, 3, 4, and 5 soil survey units, dose levels for the critical group were derived by analyzing residual levels of radioactive materials using the default residential farmer scenario in RESRAD Version 6.5 software (Yu et. al. 2001). This software analyzed the various exposure pathways (external, inhalation, ingestion) through which exposures could occur. These pathways included external and inhalation exposures and exposure from ingestion pathways including:

- Drinking water
- Food grown with contaminated irrigation water
- Food grown on contaminated soil
- Fish
- Inadvertent ingestion of soil

Land-based foods considered were:

- Leafy and root vegetables
- Fruit
- Grain
- Beef and poultry

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- Milk
- Eggs

The default residential farmer scenario was used for soil survey units with only three minor changes: 1) the actual surface area of the survey unit was used; 2) the distance of the length parallel to the aquifer was changed to the square root of the actual surface area for the survey unit; and 3) the net concentrations above background were used. This is the most conservative scenario as it assumes that persons living on the site can use the land for any purpose without land use restrictions.

For the Ship Berths 1, 2, 3, 4, and 5 concrete survey units, dose levels for the critical group were derived by analyzing residual levels of radioactive materials using the unity rule with default decontamination and decommissioning scenarios in RESRAD-BUILD Version 3.5 software, which analyzed the various exposure pathways (external, inhalation, ingestion) through which exposures could occur (Yu et. al. 2003). Modifications to the input parameters included using the actual surface area and limiting the removable fraction of the total surface contamination to 20 percent instead of 50 percent. If more than one ROC was present within the survey unit, the unity rule was applied to ensure the release criteria were not exceeded.

3.2.8 As Low As Reasonably Achievable Process for Ship Berths 1, 2, 3, 4, and 5

The ALARA process was followed for Ship Berths 1, 2, 3, 4, and 5 as detailed in the FSS report (Appendix G). For the Parcel C Phase II project area, the ALARA process was implemented through identification and review of potential radiological impacts, and the performance of qualitative and quantitative ALARA analyses.

Ship Berths 1, 2, 3, 4, and 5 were subjected to reviews before fieldwork was initiated to ensure that radiation exposures to workers, the public, and the environment met ALARA principles. ALARA reviews were conducted for all operations, practices, and procedures with the potential for individual or collective doses.

To determine environmental impacts from radiological activities, the following methods were implemented:

- Field monitoring and sampling to identify areas that may require remediation (including air, swipe, and soil samples)
- Control of the radiologically impacted area
- Air monitoring during remedial actions
- Frisking personnel and examining equipment leaving the radiologically controlled area
- Use of release criteria that equate to dose and risk

- Review of historical radiological operations to support investigations
- Characterization of Ship Berths 1, 2, 3, 4, and 5 to ensure complete removal of radioactive material exceeding the release criteria, if identified
- Dosimetry worn by personnel to measure time-averaged doses from gamma radiation

Analyses were performed on the alpha, beta, and gamma concentration data to ensure that any possible radioactive contamination was identified. Following the completion of the survey activities, the qualitative radiological impacts from operations in the field were evaluated by performing a dose and risk assessment. These results were provided to the ~~RASO-DON~~ and regulatory agencies for review.

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Based on qualitative ALARA analyses, site survey and remediation projects that could cause the potential dose to the public to exceed 1 millirem (individual) or 10 person-rem (collective) were subjected to quantitative ALARA analyses.

To date, no operations at HPNS by TtEC have resulted in an individual dose to the public greater than 1 millirem or a collective dose greater than 10 person-rem. Based on these estimates of dose to the public from the Ship Berths 1, 2, 3, 4, and 5 FSS activities, only qualitative ALARA analyses were required for the Parcel C Phase II project area. The majority of the data and analysis used for environmental ALARA evaluations were developed as part of the routine work processes. Qualitative ALARA analyses resulted in the following:

- No residual FSS measurements above the investigation levels
- None of the FSS measurement results identified residual ROC concentrations above the release criteria
- None of the personnel dosimetry badges processed identified a dose above the background level

A complete discussion of the ALARA process was provided in the Ship Berths 1, 2, 3, 4, and 5 FSS report presented in Appendix G.

3.3 ARCHAEOLOGICAL MONITORING REPORT

Archaeological monitoring for the Parcel C Phase II project area storm drain and sanitary sewer removal actions was performed in accordance with the "Final Basewide Archaeological Monitoring and Discovery Plan" (TtEC 2012b). Monitoring activities were conducted from November 2012 through November 2013 by a qualified archaeologist and archaeological technicians. During this period, a total of 8,681 linear feet of piping was removed within the archaeologically sensitive zones, resulting in the excavation of 18,644 cubic yards of soil.

The archaeological monitors inspected ground surfaces within the archaeologically sensitive areas following the removal of the paved surfaces and during excavation activities. These areas were inspected for signs of cultural materials, previous disturbance, fill, and bedrock and native soil exposures. Excavated material transferred to RSY3 or RSY4 for radiological processing was surveyed weekly on the screening pads to identify any cultural materials that were missed during the excavation activities. Daily cultural resource monitoring data sheets were filed with and reviewed by the Lead Archaeologist.

During the monitoring activities, the storm drain and sanitary sewer systems excavations yielded six artifacts resulting in four isolated finds and one small concrete foundation. The four isolated finds included:

- One 4-foot-long piling fragment
- One whiskey bottle
- One complete possible wine bottle
- One fragment of a Chinese porcelain hollowware (found in three pieces)

The overall maximum trench depths for these locations were between 7 and 10 feet bgs, which is not at sufficient depth to be below the artificial fill present in the Parcel C Phase II project area. Since each of the finds were recovered from disturbed soils with poor archaeological integrity and were without context, no further action was required. The isolated finds had a low potential for representing any interpretable archaeological resources, and did not meet the criteria to be potentially eligible for listing on the National Register of Historic Places.

Beneath the asphalt near the southeast corner of Building 253, a small concrete foundation was partially uncovered. The function of this former structure was unknown. Because it was not located on any map, the exact time frame for its construction or demolition could not be determined. Because the small concrete foundation was located above the infrastructure, it was most likely constructed after the installation of the storm drain and sanitary sewer systems. The concrete foundation was not located within the Historical Features zone and did not appear to be associated with the Maritime Resources zone. The portion of the foundation that was within the trench limits was removed to access the storm drain line beneath it. This concrete foundation was determined to have a low potential for representing any interpretable, significant architectural resource and was not considered potentially eligible for listing on the National Register of Historic Places.

No historic properties were affected by the undertaking and no noncompliance incidents occurred. The final Archaeological Monitoring Summary Report is provided in Appendix L.

3.4 IR PROGRAM SITES

Chemical contamination at HPNS was addressed through the IR Program process and was consistent with CERCLA as amended by SARA, and the NCP, to the extent practicable. Pursuant to Executive Order 12580, the DON was the lead agency responsible for implementation of the IR Program. The EPA, DTSC, Regional Water Quality Control Board, ~~RASO~~ and the United States Fish and Wildlife Service (for sensitive species) provided regulatory oversight and guidance for the CERCLA removal actions associated with HPNS.

Commented [MPL21]: Remove. RASO is not a regulatory agency for these projects.

Eight IR Program sites are associated with the Parcel C Phase II project area and include IR-6, IR-10, IR-24, IR-25, IR-28, IR-29, IR-57, and IR-58. The boundaries of these IR Program sites are identified on Figure 3-1. The individual IR Program sites associated with the Parcel C Phase II project area are listed in Table 3-9. Although the Parcel C Phase II project area removal action activities focused on potential radiological contamination, excavated soils and piping were visually inspected for staining or odors regardless of whether removal occurred within an IR Program site. Materials that emitted odors or were stained as well as materials excavated from IR Program sites were segregated in the RSYs for further activities to determine suitability for use as backfill material or waste characterization for disposal in accordance with HPNS HPO-Tt-0270 (TtEC 2006b) and the Execution Plan (TtEC 2012c). No sample collection activities or laboratory analyses were performed during the Parcel C Phase II project area removal action to meet any chemical remediation goals.

Samples of excavated soil derived from IR Program sites were collected and sent to the off-site laboratory for chemical analysis to verify whether the excavated materials met the HPNS HPO-Tt-0270 (TtEC 2006b) acceptance/reuse criteria in accordance with the approved Execution Plan (TtEC 2012c) and SAP presented as Attachment 1 to the Execution Plan (TtEC 2012c). Following analysis, the chemical analytical results were compared with the applicable release criteria. Based on this comparison, radiologically processed and released excavated soil survey units that did not meet the appropriate criteria were stockpiled for collection and off-site disposal by the DON non-LLRW contractor, along with non-IR Program site soils that exhibited odor or staining. Table 3-4 identifies the unique excavated soil survey unit identification number, associated IR Program site, if any, and final disposition of each excavated soil survey unit derived from soil generated during the Parcel C Phase II project area removal action. The chemical laboratory analytical results for each IR Program site associated with the Parcel C Phase II project area, results of data comparison with the release criteria, and identification of the elevated chemicals of concern are provided in Appendix M.

4.0 WORK AREA 31

Work Area 31 is located on the southwest side of Parcel C (Figure 1-3). It is bounded by Fisher Avenue (Parcel UC1) on the north, Blandy Street on the east, San Francisco Bay on the south, E Street and Parcel D-1 on the west, and Morrell Street on the northwest. Drydock No. 4 is centered between the west and east halves of Work Area 31 and Ship Berths 4 and 5 separate Work Area 31 from Work Area 32. The radiological activities performed in Work Area 31 included TU321, TU322, TU328, TU332, and TU339 (Figures 3-1 and 4-1). The following sections summarize the Work Area 31 radiological work activities completed during the Parcel C Phase II project area time-critical removal action.

4.1 TRENCH SURVEY UNIT 321

TU321 is located in the southern portion of Work Area 31 along Blandy Street and west of non-radiologically impacted Building 236 within Parcel C (Figures 3-1 and 4-1). TU321 connects to TU320 in Work Area 33 on the north and TU322 on the south. On the east, TU321 terminates at the Parcel C Phase II project area boundary near Ship Berths 4 and 5. The remainder of the pipe near Ship Berths 4 and 5 likely will be removed by the DON during future storm drain and sanitary sewer systems removal actions. No IR Program Sites are associated with TU321.

TU321 is composed of five storm drain trench segments and one sanitary sewer trench segment. As identified on Figure 4-1 and Table 3-1, these trench segments include:

<u>Storm Drain Trench Segments</u>	<u>Sanitary Sewer Trench Segment</u>
<ul style="list-style-type: none">• 12-C31-00-2C• 12-C31-00-2D• 12-C31-00-2E• 12-C31-00-2F• 12-C31-00-8A	<ul style="list-style-type: none">• 12-C31-00-8C

Sanitary sewer trench segment 12-C31-00-8C extends into TU322 on the south. With the exception of trench segments 12-C31-00-8A and -8C, each of the trench segments associated with TU321 was identified in the Design Plan (TtEC 2012d). Trench segment 12-C31-00-8A was found during the excavation of Manhole MH950 and trench segment 12-C31-00-8C was found during excavation of TU320.

4.1.1 TU321 Removal Action Activities

Excavation activities for TU321 were initiated on March 4, 2013 in storm drain trench segment 12-C31-00-2F. A total of 81 truckloads of soil (approximately 972 cubic yards) were excavated

from TU321 during the Parcel C Phase II project area removal action (Table 3-3). Soil generated during excavation of TU321 was transferred to RSY4 for radiological processing (Table 3-4). Following completion of the excavation on March 12, 2013, TU321 exhibited an exposed surface area of 677 m² and was 502 linear feet in length (Table 3-1). The maximum excavated TU321 depths ranged between 1 foot and 10 feet bgs (Table 3-2).

Manholes MH950, MH951, and MH952, and three sections of pipe were removed from TU321 during the Parcel C Phase II project area removal action and placed on plastic pending further activities (Figure 4-1). The majority of the TU321 piping disintegrated during removal and the debris was transferred along with the surrounding excavated soil to RSY4 for radiological processing. As indicated in Table 3-2, storm drain trench segment 12-C31-00-2E contained 10-inch-diameter UCP located at depths ranging from 5 feet to 7 feet bgs. Sanitary sewer trench segment 12-C31-00-8C contained 6-inch-diameter PVC located at depths between 1 foot and 2 feet bgs. The remainder of the trench segments associated with TU321 contained 10-inch-diameter VCP located at depths ranging from 5 feet to 9 feet bgs.

A sufficient volume of sediment was available for sample collection and analysis in Manhole MH951 (sample 12-PCMH951-008-01) and a pipe section removed from trench segment 12-C31-00-2F (sample 12-PCPI-0011-01) during the Parcel C Phase II project area removal action (Table 3-5). No ROC concentrations above the release criteria were identified in the sediment sample analytical results. The sediment sample laboratory analytical reports are provided in Appendix I.

Radiological survey activities were performed for Manholes MH950, MH951, and MH952 and two sections of pipe removed from trench segment 12-C31-00-2F during the Parcel C Phase II project area removal action (Table 3-6). Although trench segment 12-C31-00-8C pipe was removed, no survey activities were performed due to material composition. The trench segment 12-C31-00-8C PVC pipe was placed in LLRW bin GFLU001212T18 on March 14, 2013 pending off-site disposal by the DON radiological waste contractor. No elevated results were identified for Manholes MH951 or MH952, or the two sections of pipe removed from trench segment 12-C31-00-2F. The brick materials forming Manholes MH951 and MH952 and the two sections of pipe were released and the debris transferred to the DON non-LLRW contractor for off-site disposal or recycling. The survey results for Manhole MH950 (survey HPS-PCPIPE-031913-071) identified a net beta/gamma static measurement above the release limit at 1,073 dpm/100 cm². Based on this result, the brick material forming Manhole MH950 was placed in LLRW bin MHFU001131T2 on March 22, 2013 pending off-site disposal by the DON radiological waste contractor. Copies of the radiological survey reports are presented in Appendix J.

4.1.2 TU321 Piping Remaining in Place

No known storm drain or sanitary sewer systems piping associated with TU321 remained in place within Parcel C following completion of the Phase II time-critical removal action activities.

4.1.3 TU321 Final Status Survey Summary

A total of 18 systematic FSS soil samples were collected from the exposed sidewalls and bottom of TU321 and submitted to the laboratory for analysis on April 8, 2013 during the Parcel C Phase II project area removal action. No ROC concentrations above the release criteria specified in the AM (DON 2006) or the remediation goals established in the ROD (DON 2010) were identified in the TU321 FSS soil sample analytical results. The release criteria are identified in Tables 2-1 and 2-3, and the remediation goals are presented in Table 2-2. Figure 4-1 depicts the FSS soil sample collection locations in TU321. The range in the gamma scan and static count rates, and the FSS laboratory analytical reports are presented in Attachments 1 and 3, respectively, to the TU321 SUPR provided in Appendix C.

For the FSS, TU321 was defined as the sum of the trench unit and the backfill materials composed of both radiologically processed and released excavated soil survey units and a volume of imported fill. The average net residual ROC concentrations for materials used as backfill in TU321 were 0.021 pCi/g for Cs-137, 0.168 pCi/g for Sr-90, and -0.118 pCi/g for Ra-226. The trench unit average net residual ROC concentrations were 0.021 pCi/g for Cs-137, 0.265 pCi/g for Sr-90, and -0.039 pCi/g for Ra-226. The net Ra-226 concentration (with background Ra-226 subtracted) was used to calculate dose and risk. No background was subtracted from the Cs-137 or Sr-90 values since these radionuclides were not naturally occurring or expected due to nuclear weapons testing fallout at pipe depths.

RESRAD modeling using the larger of the MDL or net residual ROC and their decay product concentrations resulted in a dose of 0.5015 mrem/y with an increased cancer risk of 6.488×10^{-6} for the backfill material and 0.7679 mrem/y with an increased cancer risk of 9.857×10^{-6} for the trench unit (Yu et. al. 2001). These results were less than the NRC criterion of 25 mrem/y and the increased cancer risk falls within the EPA risk management range of 10^{-6} to 10^{-4} . The modeling parameters, values, and results were presented in Attachments 7 and 8 to the TU321 SUPR (Appendix C).

The results of the modeling efforts determined that the potential TU321 dose due to net residual ROC and their decay product concentrations greater than or equal to the MDL was 0.7679 mrem/y with an increased cancer risk of 9.857×10^{-6} , which supports radiological free release. Qualitative ALARA analyses resulted in: 1) no FSS gamma survey count rates above the investigation levels, 2) none of the FSS sample results identified net residual ROC concentrations above the release criteria, 3) no air monitoring results exceeded 10 percent of the derived air concentration for the public, and 4) no personnel dosimetry badges processed identified doses above background levels. No further radiological action was recommended in the TU321 SUPR (Appendix C). Table 3-1 summarizes the activities performed during the Parcel C Phase II project area removal action to support the recommended radiological free release of TU321.

4.1.4 TU321 Backfill Activities

Radiologically processed and released excavated soil survey units and a volume of imported fill were selected as the backfill materials for TU321. The excavated soil survey units selected as backfill materials included:

- ES-802
- ES-806

Radiological information related to the processing of these excavated soil survey units is summarized in Table 3-4 and the associated laboratory analytical results are discussed in the TU321 SUPR (Appendix C). The radiological and chemical analytical reports for the imported fill are provided in Appendix K.

The **RASO** **DON** concurred with backfilling TU321 on June 12, 2013 (Table 3-1). Backfill operations commenced on June 27, 2013 and were completed on July 1, 2013. An estimated 598 cubic yards of soil was placed in TU321 to grade followed by the application of road base material over the backfilled trench. In addition, a stormwater swale was constructed over a portion of the backfilled trench. Backfill activities were performed in accordance with the HPNS Basewide Construction Specifications (TtEC 2012e). Parcel C Phase II project area restoration activities are described in Section 9.0.

Commented [MPL22]: Navy

4.2 TRENCH SURVEY UNIT 322

TU322 is located in the southern portion of Work Area 31 along Blandy Street in Parcel C and west of Ship Berths 5, 6, and 9 (Figures 3-1 and 4-1). TU322 connects to TU321 on the north, TU236 on the west, and terminates on the south near North Pier Survey Unit 11. On the east, TU322 terminates at the Parcel C Phase II project area boundary near Ship Berth 5. The remainder of the pipe near Ship Berth 5 likely will be removed by the DON during future storm drain and sanitary sewer systems removal actions. No IR Program Sites are associated with TU322.

TU322 consists of five storm drain trench segments and one sanitary sewer trench segment. As identified on Figure 4-1 and Table 3-1, these trench segments include:

Storm Drain Trench Segments

- 12-C31-00-2L
- 12-C31-00-2M
- 12-C31-00-2N
- 12-C31-00-2O
- 12-C31-00-8B

Sanitary Sewer Trench Segment

- 12-C31-00-8C

On the north, sanitary sewer trench segment 12-C31-00-8C transitions into TU321. With the exception of trench segments 12-C31-00-8B and -8C, each of the trench segments associated with TU322 was identified in the Design Plan (TtEC 2012d). Trench segment 12-31-00-8B was found during excavation of Manhole MH945 and trench segment 12-C31-00-8C was found during excavation of TU321.

4.2.1 TU322 Removal Action Activities

Excavation activities for TU322 commenced on March 7, 2013 in storm drain trench segments 12-C31-00-2L, -2M, and -2N. A total of 38 truckloads of soil (approximately 456 cubic yards) were excavated from TU322 during the Parcel C Phase II project area removal action (Table 3-3). Soil generated during excavation of TU322 was transferred to RSY4 for radiological processing (Table 3-4). Following completion of the excavation on March 12, 2013, TU322 had an exposed surface area of 588 m² and was 514 linear feet in length (Table 3-1). The maximum excavated TU322 depths ranged between 1 foot and 8 feet bgs (Table 3-2).

Manholes MH944, MH945 and MH1344, and 12 sections of pipe were removed from TU322 during the Parcel C Phase II project area removal action and placed on plastic pending further activities (Figure 4-1). The majority of the TU322 piping crumbled during removal and the debris was transferred along with the surrounding excavated soil to RSY4 for radiological processing. As indicated in Table 3-2, sanitary sewer trench segment 12-C31-00-8C contained 6-inch-diameter PVC pipe located at depths between 1 foot and 3 feet bgs. Storm drain trench segment 12-C31-00-2L contained 12-inch-diameter RCP located an approximate depth of 4 feet bgs.

An insufficient volume of sediment was available for sample collection and analysis in Manholes MH944, MH945 and MH1344, or the pipe sections removed from TU322 during the Parcel C Phase II project area removal action. Consequently, there are no sediment sample analytical results associated with TU322.

Radiological survey activities were performed for Manholes MH944, MH945, and MH1344, seven sections of pipe removed from trench segment 12-C31-00-2L, and three sections of pipe removed from trench segment 12-C31-00-2O (Table 3-6). Pipe also was removed from trench segments 12-C31-00-8B and -8C and was placed in LLRW bin GFLU001212T18 on March 14, 2013 for off-site disposal by the DON radiological waste contractor since the sections could not be properly surveyed. The survey results for Manhole MH945 (survey HPS-PCPIPE-031913-071) identified a net beta/gamma static measurement above the release limit at 1,226 dpm/100 cm². Based on this result, the brick material forming Manhole MH945 was placed in LLRW bin GFLU001259T13 on March 22, 2013 pending off-site disposal by the DON radiological waste contractor. No elevated survey results were identified for Manholes MH944 or MH1344, or the 10 sections of pipe removed from trench segments 12-C31-00-2L and -2O. Based on these results, the brick material forming Manholes MH944 and MH1344, the seven sections of pipe removed from trench segment

12-C31-00-2L, and the three sections of pipe removed from trench segment 12-C31-00-2O were released and the debris transferred to the DON non-LLRW contractor for off-site disposal or recycling. Copies of the radiological survey reports are presented in Appendix J.

4.2.2 TU322 Piping Remaining in Place

No known storm drain or sanitary sewer systems piping associated with TU322 remained in place within Parcel C following completion of the Phase II time-critical removal action activities.

4.2.3 TU322 Final Status Survey Summary

Eighteen systematic FSS soil samples were collected from the exposed sidewalls and bottom of TU322 and submitted to the laboratory for analysis on April 5, 2013 during the Parcel C Phase II project area removal action. No ROC concentrations above the release criteria specified in the AM (DON 2006) or the remediation goals established in the ROD (DON 2010) were identified in the TU322 FSS soil sample analytical results. The release criteria are identified in Tables 2-1 and 2-3, and the remediation goals are presented in Table 2-2. Figure 4-1 depicts the FSS soil sample collection locations in TU322. The range in the gamma scan survey and static survey count rates, and the FSS laboratory analytical reports were presented in Attachments 1 and 3, respectively, to the TU322 SUPR provided in Appendix C.

TU322 was defined for the FSS as the sum of the trench unit and the backfill materials composed of both a radiologically processed and released excavated soil survey unit and a volume of imported fill. The average net residual ROC concentrations for materials used as backfill in TU322 were 0.020 pCi/g for Cs-137, 0.195 pCi/g for Sr-90, and -0.124 pCi/g for Ra-226. The trench unit average net ROC concentrations were 0.020 pCi/g for Cs-137, 0.213 pCi/g for Sr-90, and -0.083 pCi/g for Ra-226. The net Ra-226 concentration (with background Ra-226 subtracted) was used to calculate the dose and risk. No background was subtracted from the Cs-137 or Sr-90 values since these radionuclides were not naturally occurring or expected due to nuclear weapons testing fallout at pipe depths.

RESRAD modeling using the larger of the MDL or the net residual ROC concentration resulted in a dose of 0.5032 mrem/y with an increased cancer risk of 6.502×10^{-6} for the backfill material and 0.5461 mrem/y with an increased cancer risk of 7.045×10^{-6} for the trench unit (Yu et. al. 2001). These results were less than the NRC criterion of 25 mrem/y and the increased cancer risk falls within the EPA risk management range of 10^{-6} to 10^{-4} . The modeling parameters, values, and results were presented in Attachments 7 and 8 to the TU322 SUPR (Appendix C).

The results of the modeling efforts determined that the potential TU322 dose due to the net residual ROC and their decay product concentrations greater than or equal to the MDL was 0.5461 mrem/y with an increased cancer risk of 7.045×10^{-6} , which supports radiological free release. Qualitative ALARA analyses resulted in: 1) no FSS gamma survey measurements above the

investigation levels, 2) none of the FSS sample results identified net residual ROC concentrations above the release criteria, 3) no air monitoring results exceeded 10 percent of the derived air concentration for members of the public, and 4) no personnel dosimetry badges processed identified doses above background levels. No further radiological action was recommended in the TU322 SUPR (Appendix C). Table 3-1 summarizes the activities performed during the Parcel C Phase II project area removal action to support the recommended radiological free release of TU322.

4.2.4 TU322 Backfill Activities

Radiologically processed and released excavated soil survey unit ES-805 and a volume of imported fill were selected as the backfill material for TU322. Radiological information related to the processing of ES-805 is summarized in Table 3-4 and the associated laboratory analytical results are discussed in the TU322 SUPR (Appendix C). The radiological and chemical analytical reports for the imported fill are provided in Appendix K.

Concurrence with backfilling TU322 was obtained from the [RASO-DON](#) on May 29, 2013 (Table 3-1). Backfill operations began on June 10, 2013 and were completed on June 12, 2013. An estimated 390 cubic yards of soil was placed in TU322 to grade followed by the application of road base material over the backfilled trench. Backfill activities were performed in accordance with the HPNS Basewide Construction Specifications (TtEC 2012e). Parcel C Phase II project area restoration activities are described in Section 9.0.

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4.3 TRENCH SURVEY UNIT 328

Physically separated into two distinct sections, TU328 is located in the northern portion of Work Area 31 and the western portion of Work Area 33 near Blandy Street and just south of Spear Avenue in Parcel C (Figures 3-1 and 4-1). On the north, TU328 connects to TU 213, which was excavated during the first phase of the Parcel C project area time-critical removal action. On the south, TU328 connects to TU329. TU328 connects to TU329 on the west, which also was excavated during the first phase of the Parcel C project area time-critical removal action. No IR Program Sites are associated with the larger section of TU328; however, the smaller section of TU328 is situated within IR Program Site IR-57. The chemicals of concern associated with IR-57 are listed in Table 3-9.

TU328 is composed of seven storm drain trench segments and one sanitary sewer trench segment. As identified on Figure 4-1 and Table 3-1, these trench segments include:

Storm Drain Trench Segments

- 12-C31-57-1C
- 12-C31-57-1D

Sanitary Sewer Trench Segment

- 12-C33-00-1G

- 12-C31-57-1E
- 12-C31-57-1G
- 12-C33-00-1J
- 12-C33-00-2Z
- 12-C33-00-3B

Trench segments 12-C33-00-1G and -2Z transition into TU329 on the south. Each of the trench segments associated with TU328 was identified in the Design Plan (TtEC 2012d).

4.3.1 TU328 Removal Action Activities

Excavation activities for TU328 began on May 7, 2013 in storm drain trench segments 12-C31-57-1D and -1E. A total of 75 truckloads of soil (approximately 900 cubic yards) were excavated from TU328 during the Parcel C Phase II project area removal action (Table 3-3). Soil generated during excavation of TU328 was transferred to RSY4 for radiological processing (Table 3-4). Following completion of the excavation on June 6, 2013, TU328 exhibited an exposed surface area of 642 m² and was 352 linear feet in length (Table 3-1). The maximum excavated TU328 depths ranged between 4 feet and 10 feet bgs (Table 3-2).

Manhole MH923 and 14 sections of pipe were removed from TU328 during the Parcel C Phase II project area removal action and placed on plastic pending further activities (Figure 4-1). The majority of the TU328 piping disintegrated during removal and the debris was transferred along with the surrounding excavated soil to RSY4 for radiological processing. As indicated in Table 3-2, sanitary sewer trench segment 12-C33-00-1G contained 21-inch-diameter RCP located at depths between 7 feet and 8 feet bgs. Storm drain trench segment 12-C31-57-1E contained 4-inch-diameter VCP located at depths between 3 feet and 4 feet bgs. Storm drain trench segments 12-C33-00-1J and -2Z contained 27-inch-diameter VCP located at depths ranging from 7 feet to 8 feet bgs. The remainder of the TU328 trench segments contained 10-inch-diameter VCP located at depth between 3 feet and 8 feet bgs.

A sufficient volume of sediment was available for sample collection and analysis in Manhole MH923 (sample 12-PCMH923-009-01) during the Parcel C Phase II project area removal action (Table 3-5). No ROC concentrations above the release criteria were identified in the sediment sample analytical results. The sediment sample laboratory analytical reports are provided in Appendix I.

Radiological survey activities were performed for Manhole MH923 and 14 sections of pipe removed from trench segment 12-C33-00-1J during the Parcel C Phase II project area removal action (Table 3-6). No elevated results were identified for this manhole or the 14 sections of pipe removed from trench segment 12-C33-00-1J. Based on these results, the brick material forming

Manhole MH923 and the 14 sections of pipe were released and the debris transferred to the DON non-LLRW contractor for off-site disposal or recycling. Copies of the radiological survey reports are presented in Appendix J.

4.3.2 TU328 Piping Remaining in Place

No known storm drain or sanitary sewer systems piping associated with TU328 remained in place within Parcel C following completion of the Phase II time-critical removal action activities.

4.3.3 TU328 Final Status Survey Summary

A total of 18 systematic FSS soil samples were collected from the exposed sidewalls and bottom of TU328 and submitted to the laboratory for analysis on June 27, 2013 during the Parcel C Phase II project area removal action. No ROC concentrations above the release criteria specified in the AM (DON 2006) or the remediation goals established in the ROD (DON 2010) were identified in the TU328 FSS soil sample analytical results. The release criteria are identified in Tables 2-1 and 2-3, and the remediation goals are presented in Table 2-2. Figure 4-1 depicts the FSS soil sample collection locations in TU328. The range in the gamma scan survey and static survey count rates, and the FSS laboratory analytical reports were presented in Attachments 1 and 3, respectively, to the TU328 SUPR provided in Appendix C.

For the FSS, TU328 was defined as the sum of the trench unit and the backfill materials composed of both radiologically processed and released excavated soil survey units and a volume of imported fill. The average net residual ROC concentrations for materials used as backfill in TU328 were 0.019 pCi/g for Cs-137, 0.191 pCi/g for Sr-90, and -0.056 pCi/g for Ra-226. The trench unit average net residual ROC concentrations were 0.019 pCi/g for Cs-137, 0.202 pCi/g for Sr-90, and -0.027 pCi/g for Ra-226. The net Ra-226 concentration (with background Ra-226 subtracted) was used to calculate dose and risk. No background was subtracted from the Cs-137 or Sr-90 values since these radionuclides were not naturally occurring or expected due to nuclear weapons testing fallout at pipe depths.

RESRAD modeling using the larger of the MDL or reported net residual ROC concentrations resulted in a dose of 0.5337 mrem/y with an increased cancer risk of 6.881×10^{-6} for the backfill material and 0.5623 mrem/y with an increased cancer risk of 7.243×10^{-6} for the trench unit (Yu et. al. 2001). These results were less than the NRC criterion of 25 mrem/y and the increased cancer risk falls within the EPA risk management range of 10^{-6} to 10^{-4} . The modeling parameters, values, and results were presented in Attachments 7 and 8 to the TU328 SUPR (Appendix C).

The results of the modeling efforts determined that the potential TU328 dose due to net residual ROC and their decay product concentrations greater than or equal to the MDL was 0.5623 mrem/y with an increased cancer risk of 7.243×10^{-6} , which supports radiological free release. Qualitative ALARA analyses resulted in: 1) no FSS gamma survey measurements above the

investigation levels, 2) none of the FSS sample results identified net residual ROC concentrations above the release criteria, 3) no air monitoring results exceeded 10 percent of the derived air concentration for members of the public, and 4) no personnel dosimetry badges processed identified doses above background levels. No further radiological action was recommended in the TU328 SUPR (Appendix C). Table 3-1 summarizes the activities performed during the Parcel C Phase II project area removal action to support the recommended radiological free release of TU328.

4.3.4 TU328 Backfill Activities

Radiologically processed and released excavated soil survey units and a volume of imported fill were selected as the backfill materials for TU328. The excavated soil survey units selected as backfill material included:

- ES-816
- ES-823
- ES-824

Radiological information related to the processing of these excavated soil survey units is summarized in Table 3-4 and the associated laboratory analytical results are discussed in the TU328 SUPR (Appendix C). The radiological and chemical analytical reports for the imported fill are provided in Appendix K.

At the direction of the DON, backfill operations were initiated for TU328 on October 4, 2013 and completed on October 11, 2013. Although the draft TU328 SUPR and request for backfill was submitted to the RASO-DON on July 31, 2013, concurrence with backfilling TU328 was not obtained until November 8, 2013 (Table 3-1). An estimated 762 cubic yards of soil was placed in TU328 to grade followed by the application of road base material over the backfilled trench. In addition, a stormwater swale was constructed over a portion of the backfilled trench. Backfill activities were performed in accordance with the HPNS Basewide Construction Specifications (TtEC 2012e). Parcel C Phase II project area restoration activities are described in Section 9.0.

Commented [MPL24]: Navy

4.4 TRENCH SURVEY UNIT 332

TU332 is located in the southwest corner of Work Area 33 and the eastern portion of Work Area 31 at the intersection of Blandy and C Streets in Parcel C (Figures 3-1 and 4-1). On the north, TU332 connects to TU331 and TU321. TU332 connects to TU339 on the west and TU236 on the south, which was removed during the first phase of the Parcel C project area time-critical removal action. A small segment of TU332 is situated with IR Program Site IR-57. The chemicals of concern associated with IR-57 are listed in Table 3-9.

TU332 consists of five storm drain trench segments and no sanitary sewer trench segments. As identified on Figure 4-1 and Table 3-1, these trench segments include:

- 12-C31-00-1X
- 12-C31-00-1Y
- 12-C31-00-2T
- 12-C31-57-2N
- 12-C33-00-3Z

Trench segment 12-C33-00-3Z transitions into TU331 on the northwest. Each of the trench segments associated with TU332 was identified in the Design Plan (TtEC 2012d). Although identified in the Design Plan and associated with a utility vault, trench segments 12-C31-00-2A and -2B could not be found after several excavation attempts.

4.4.1 TU332 Removal Action Activities

Excavation activities for TU332 were initiated on May 30, 2013 in storm drain trench segments 12-C31-00-2B and -2T. A total of 92 truckloads of soil (approximately 1,104 cubic yards) were excavated from TU332 during the Parcel C Phase II project area removal action (Table 3-3). Soil generated during excavation of TU332 was transferred to both RSY3 and RSY4 for radiological processing (Table 3-4). Following completion of the excavation on June 6, 2013, TU332 had an exposed surface area of 634 m² and was 260 linear feet in length (Table 3-1). The maximum excavated TU332 depths ranged between 7 feet and 9 feet bgs (Table 3-2).

Manhole MH947 and 33 sections of pipe were removed from TU332 during the Parcel C Phase II project area removal action and placed on plastic pending further activities (Figure 4-1). The majority of the TU332 piping crumbled during removal and the debris was transferred along with the surrounding excavated soil to either RSY3 or RSY4 for radiological processing. As indicated in Table 3-2, storm drain trench segment 12-C31-00-1Y contained 12-inch-diameter UCP located at a depth of approximately 6 feet bgs. Trench segment 12-C31-57-2N contained 10-inch-diameter UCP located at a depth of about 6 feet bgs. The remaining trench segments contained 20-inch-diameter VCP located at an estimated depth of 6 feet bgs.

A sufficient volume of sediment was available for sample collection and analysis in a section of pipe removed from trench segment 12-C31-00-2T (sample 12-PCPI-0013-01) during the Parcel C Phase II project area removal action (Table 3-5). No ROC concentrations above the release criteria were identified in the sediment sample analytical results. The sediment sample laboratory analytical report is provided in Appendix I.

Radiological survey activities were performed for Manhole MH947 (survey HPS-PCPIPE-071513-078), 4 sections of pipe removed from trench segment 12-C31-00-1X (survey HPS-PCPIPE-072613-088), 28 sections of pipe removed from trench segment 12-C31-00-2T (surveys HPS-PCPIPE-072913-090 and HPS-PCPIPE-072913-091), and 1 section removed from trench

segment 12-C33-00-3Z (survey HPS-PCPIPE-072513-085) during the Parcel C Phase II project area removal action (Table 3-6). No elevated results were identified for Manhole MH947 or the 33 pipe sections surveyed. Based on these results, the brick material forming Manhole MH947 and the 33 sections of pipe were released and the debris transferred to the DON non-LLRW contractor for off-site disposal or recycling. Copies of the radiological survey reports are presented in Appendix J.

4.4.2 TU332 Piping Remaining in Place

No known storm drain or sanitary sewer systems piping associated with TU332 remained in place within Parcel C following completion of the Phase II time-critical removal action activities.

4.4.3 TU332 Final Status Survey Summary

Eighteen systematic FSS soil samples were collected from the exposed sidewalls and bottom of TU332 and submitted to the laboratory for analysis on July 12, 2013 during the Parcel C Phase II project area removal action. No ROC concentrations above the release criteria specified in the AM (DON 2006) or the remediation goals established in the ROD (DON 2010) were identified in the TU332 FSS soil sample analytical results. The release criteria are identified in Tables 2-1 and 2-3, and the remediation goals are presented in Table 2-2. Figure 4-1 depicts the FSS soil sample collection locations in TU332. The gamma scan ranges and static measurement values, and the FSS laboratory analytical reports were presented in Attachments 1 and 3, respectively, to the TU332 SUPR provided in Appendix C.

TU332 was defined for the FSS as the sum of the trench unit and the backfill materials composed of both radiologically processed and released excavated soil survey units and a volume of imported fill. The average net residual ROC concentrations for materials used as backfill in TU332 were 0.020 pCi/g for Cs-137, 0.165 pCi/g for Sr-90, and -0.114 pCi/g for Ra-226. The trench unit average net residual ROC concentrations were 0.025 pCi/g for Cs-137, 0.142 pCi/g for Sr-90, and -0.142 pCi/g for Ra-226. The net Ra-226 concentration (with background Ra-226 subtracted) was used to calculate dose and risk. No background was subtracted from the Cs-137 or Sr-90 values since these radionuclides were not naturally occurring or expected due to nuclear weapons testing fallout at pipe depths.

RESRAD modeling using the larger of the MDL or reported net ROC and their decay product concentrations resulted in a dose of 0.4624 mrem/y with an increased cancer risk of 5.987×10^{-6} for the backfill material and 0.4127 mrem/y with an increased cancer risk of 5.394×10^{-6} for the trench unit (Yu et. al. 2001). These results were less than the NRC criterion of 25 mrem/y and the increased cancer risk falls within the EPA risk management range of 10^{-6} to 10^{-4} . The modeling parameters, values, and results were presented in Attachments 7 and 8 to the TU332 SUPR (Appendix C).

The results of the modeling efforts determined that the potential TU332 dose due to net residual ROC and their decay products concentrations greater than or equal to the MDL was 0.4624 mrem/y with an increased cancer risk of 5.987×10^{-6} , which supports radiological free release. Qualitative ALARA analyses resulted in: 1) no FSS gamma survey measurements above the investigation levels, 2) none of the FSS sample results identified net residual ROC and their decay product concentrations above the release criteria, 3) no air monitoring results exceeded 10 percent of the derived air concentration for members of the public, and 4) no personnel dosimetry badges processed identified doses above background levels. No further radiological action was recommended in the TU332 SUPR (Appendix C). Table 3-1 summarizes the activities performed during the Parcel C Phase II project area removal action to support the recommended radiological free release of TU332.

4.4.4 TU332 Backfill Activities

Radiologically processed and released excavated soil survey units and a volume of imported fill were selected as the backfill materials for TU332. The excavated soil survey units selected as backfill materials included:

- ES-831
- ES-832
- ES-833

Radiological information related to the processing of these excavated soil survey units is summarized in Table 3-4 and the associated laboratory analytical results are discussed in the TU332 SUPR (Appendix C). The radiological and chemical analytical reports for the imported fill are provided in Appendix K.

At the direction of the DON, backfill operations were initiated for TU332 on October 8, 2013 and completed on October 22, 2013. Although the draft TU332 SUPR and request for backfill was submitted to the ~~RASO-DON~~ on October 1, 2013, concurrence with backfilling TU332 was not obtained until November 8, 2013 (Table 3-1). An estimated 897 cubic yards of soil was placed in TU332 to grade followed by the application of road base material over the backfilled trench. In addition, a stormwater swale was constructed over a portion of the backfilled trench. Backfill activities were performed in accordance with the HPNS Basewide Construction Specifications (TtEC 2012e). Parcel C Phase II project area restoration activities are described in Section 9.0.

4.5 TRENCH SURVEY UNIT 339

TU339 is located on the southeast side of Work Area 31 within Parcel C, northeast of Building 236, and west of Ship Berth 5 (Figures 3-1 and 4-1). TU339 terminates approximately 15 feet

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from the San Francisco Bay outfall on the east and connects to TU332 on the west. No IR Program Sites are associated with TU339.

As identified on Figure 4-1 and Table 3-1, TU339 is composed of storm drain trench segment 12-C31-00-2G. Although identified in the Design Plan (TtEC 2012d), 15 feet of 12-C31-00-2G was not removed to facilitate swale construction connections.

4.5.1 TU339 Removal Action Activities

Excavation activities for TU339 began on October 9, 2013 in trench segment 12-C31-00-2G. A total of 28 truckloads of soil (approximately 336 cubic yards) were excavated from TU339 during the Parcel C Phase II project area removal action (Table 3-3). Soil generated during excavation of TU339 was transferred to RSY4 for radiological processing (Table 3-4). Following completion of the excavation on October 10, 2013, TU339 exhibited an exposed surface area of 223 m² and was 80 linear feet in length (Table 3-1). The maximum excavated TU339 depth was 9 feet bgs (Table 3-2).

Manhole MH949 and four sections of pipe were removed from TU339 during the Parcel C Phase II project area removal action and placed on plastic pending further activities (Figure 4-1). The majority of the TU339 piping disintegrated upon removal and the debris was transferred along with the surrounding excavated soil to RSY4 for radiological processing. As indicated in Table 3-2, storm drain trench segment 12-C31-00-2G contained 30-inch-diameter VCP located at a depth of approximately 7 feet bgs.

An insufficient volume of sediment was available for sample collection and analysis during the Parcel C Phase II project area removal action activities. Consequently, no sediment sample analytical results were associated with TU339.

Radiological survey activities were performed for manhole MH949 (survey HPS-PCPIPE-102313-109) and four sections of pipe removed from trench segment 12-C31-00-2G (survey HPS-PCPIPE-102313-110) during the Parcel C Phase II project area removal action (Table 3-6). No results above the release limits were identified for MH949 or the four sections of trench segment 12-C31-00-2G pipe. Based on these results, the brick and concrete materials forming MH949 and the four sections of VCP were release and transferred to the DON non-LLRW contractor for off-site disposal or recycling.

4.5.2 TU339 Piping Remaining In Place

Approximately 60 linear feet of trench segment 12-C31-00-2G 30-inch-diameter VCP was excavated prior to being terminated near Ship Berth 5 during the Parcel C Phase II removal action. Based on historical drawings, an estimated 15 linear feet of pipe remained in place to facilitate future swale construction and connection activities (Table 3-7). To ensure that no residual

radioactivity above the release criteria was associated with the 15 linear feet of pipe remaining in place, radiological survey activities were performed on October 23, 2013 at the western terminus of the pipe remaining in place (survey HPS-PCPIPE-102313-111). No elevated results were identified for the pipe remaining in place near Ship Berth 5. Based on these results, the DON concluded that the 15 feet of pipe remaining in place was unlikely to be contaminated. A copy of the survey report is provided in Appendix J.

4.5.3 TU339 Final Status Survey Summary

Eighteen systematic soil samples were collected from the exposed sidewalls and bottom of TU339 and submitted to the laboratory for analysis on December 6, 2013 during the Parcel C Phase II project area removal action. No ROC concentrations above the release criteria specified in the AM (DON 2006) or the remediation goals established in the ROD (DON 2010) were identified in the TU339 FSS soil sample analytical results. The release criteria are identified in Tables 2-1 and 2-3, and the remediation goals are presented in Table 2-2. Figure 4-1 depicts the FSS soil sample collection locations in TU339. The gamma scan ranges and static measurement values, and the FSS laboratory analytical reports were presented in Attachments 1 and 3, respectively, to the TU339 SUPR provided in Appendix C.

TU339 was defined for the FSS as the sum of the trench unit and the backfill materials composed of both radiologically processed and released excavated soil survey unit ES-855 and a volume of imported fill. The average net residual ROC concentrations for materials used as backfill in TU339 were 0.021 pCi/g for Cs-137, 0.153 pCi/g for Sr-90, and -0.081 pCi/g for Ra-226. The trench unit average net residual ROC concentrations were 0.022 pCi/g for Cs-137, 0.157 pCi/g for Sr-90, and -0.140 pCi/g for Ra-226. The net Ra-226 concentration (with background Ra-226 subtracted) was used to calculate dose and risk. No background was subtracted from the Cs-137 or Sr-90 values since these radionuclides were not naturally occurring or expected due to nuclear weapons testing fallout at pipe depths.

RESRAD modeling using the larger of the MDL or reported net ROC concentrations and their decay products resulted in a dose of 0.1762 mrem/y with an increased cancer risk of 2.366×10^{-6} for the backfill material and 0.1815 mrem/y with an increased cancer risk of 2.441×10^{-6} for the trench unit (Yu et. al. 2001). These results were less than the NRC criterion of 25 mrem/y and the increased cancer risk falls within the EPA risk management range of 10^{-6} to 10^{-4} . The modeling parameters, values, and results were presented in Attachments 7 and 8 to the TU339 SUPR (Appendix C).

The results of the modeling efforts determined that the potential TU339 dose due to net residual ROC concentrations greater than or equal to the MDL was 0.1815 mrem/y with an increased cancer risk of 2.441×10^{-6} , which supports radiological free release. Qualitative ALARA analyses resulted in: 1) no FSS gamma survey measurements above the investigation levels, 2)

none of the FSS sample results identified residual ROC concentrations above the release criteria, 3) no air monitoring results exceeded 10 percent of the derived air concentration for members of the public, and 4) no personnel dosimetry badges processed identified doses above background levels. No further radiological action was recommended in the TU339 SUPR (Appendix C). Table 3-1 summarizes the activities performed during the Parcel C Phase II project area removal action to support the recommended radiological free release of TU339.

4.5.4 TU339 Backfill Activities

Radiologically processed and released excavated soil survey unit ES-855 and a volume of imported fill were selected as the backfill materials for TU339. Radiological information related to the processing of ES-855 is summarized in Table 3-4 and the associated laboratory analytical results were discussed in the TU339 SUPR (Appendix C). The radiological and chemical analytical reports for the imported fill are provided in Appendix K.

The DON concurred with backfilling TU339 on January 29, 2014 (Table 3-1). Backfill operations commenced on January 31, 2014 and were completed on February 3, 2014. An estimated 324 cubic yards of soil was placed in TU339 to grade followed by the application of road base material over the backfilled trench. Backfill activities were performed in accordance with the HPNS Basewide Construction Specifications (TtEC 2012e). Parcel C Phase II project area restoration activities are described in Section 9.0.

5.0 WORK AREA 33

Work Area 33 is located in the central portion of Parcel C (Figure 1-3). It is bounded by Van Keuren Avenue on the north, Lockwood Street on the east, Work Area 31 on the south, Blandy Street on the west, and Parcel UC2 (Fisher Avenue) on the northwest. The radiological activities performed in Work Area 33 were limited to TU315, TU316, TU317, TU318, TU319, TU320, TU329, TU330, TU331, and TU338 (Figures 3-1 and 5-1). The following sections summarize the radiological work activities completed in Work Area 33 during the Parcel C Phase II project area removal action.

5.1 TRENCH SURVEY UNIT 315

TU315 is located in the southeast corner of Work Area 33 along Nimitz Avenue within Parcel C (Figures 3-1 and 5-1). TU315 connects to TU338 on the east and TU316 on the west. On the north, TU315 terminates within the 10-foot buffer zone surrounding non-radiologically impacted Building 228. On the south, TU315 terminates at Manhole MH965 just north of Building C-J. The majority of trench segments associated with TU315 are situated within IR Program Site IR-28. The chemicals of concern associated with IR-28 are listed in Table 3-9.

TU315 is composed of four storm drain trench segments and two sanitary sewer trench segments. As identified on Figure 5-1 and Table 3-1, these trench segments include:

<u>Storm Drain Trench Segments</u>	<u>Sanitary Sewer Trench Segments</u>
<ul style="list-style-type: none">• 12-C33-00-4S• 12-C33-28-3O• 12-C33-28-3Q• 12-C33-28-8D	<ul style="list-style-type: none">• 12-C33-28-3L• 12-C33-28-3N

Trench segments 12-C33-28-3L, -3N, -3O, and -3Q transition into TU316 on the west. Trench segments 12-C33-28-3L and -3O also extend into TU338 on the east and trench segment 12-C33-28-3N continues into TU327 on the north. With the exception of storm drain trench segment 12-C33-28-8D, each of the trench segments associated with TU315 was identified in the Design Plan (TiEC 2012d). Trench segment 12-C33-28-8D was found during excavation of pipe sections from trench segment 12-C33-28-3N.

5.1.1 TU315 Removal Action Activities

Excavation activities for TU315 were initiated on January 23, 2013 in trench segment 12-C33-28-3L. A total of 112 truckloads of soil (approximately 1,344 cubic yards) were excavated from TU315 during the Parcel C Phase II project area removal action (Table 3-3). Soil generated during

excavation of TU315 was transferred to both RSY3 and RSY4 for radiological processing (Table 3-4). Following completion of the excavation on February 8, 2013, TU315 exhibited an exposed surface area of 967 m² and was 343 linear feet in length (Table 3-1). The maximum excavated TU315 depths ranged between 6 feet and 8 feet bgs (Table 3-2).

Manhole MH965 and 13 sections of pipe were removed from TU315 during the Parcel C Phase II project area removal action and placed on plastic pending further activities (Figure 5-1). The majority of the TU315 piping disintegrated during removal and the debris was transferred along with the surrounding excavated soil to RSY3 or RSY4 for radiological processing. As indicated in Table 3-2, sanitary sewer trench segment 12-C33-28-3L contained 18-inch-diameter RCP located at depths from 6 feet to 7 feet bgs and sanitary sewer trench segment 12-C33-28-3N contained 6-inch-diameter VCP at depths between 7 feet and 8 feet bgs. Storm drain trench segments 12-C33-00-4S and 12-C33-28-3Q contained 10-inch-diameter VCP located at depths ranging from 5 feet to 6 feet bgs. Storm drain trench segments 12-C33-28-8D and -3O contained 6-inch-diameter and 12-inch-diameter VCP, respectively. The pipes in these two trench segments were found at depths ranging from 6 feet to 7 feet bgs.

An insufficient volume of sediment was available for sample collection and analysis in Manhole MH965 and the 13 sections of pipe removed from TU315 during the Parcel C Phase II project area removal action. Consequently, there are no sediment sample analytical results associated with TU315.

Radiological survey activities were performed for Manhole MH965 and the 13 sections of pipe removed from trench segment 12-C33-28-3L (Table 3-6). No elevated results were identified for the TU315 piping surveyed. Based on these results, the brick materials forming Manhole MH965 and the 13 sections of trench segment 12-C33-28-3L RCP were released and the debris transferred to the DON non-LLRW contractor for off-site disposal or recycling. Copies of the radiological survey reports are presented in Appendix J.

5.1.2 TU315 Piping Remaining in Place

No known storm drain or sanitary sewer systems piping associated with TU315 remained in place within Parcel C following completion of the Phase II time-critical removal action activities.

5.1.3 TU315 Final Status Survey Summary

During the FSS activities, a total of 18 systematic soil samples were collected from the exposed sidewalls and bottom of TU315 on February 22, 2013 and submitted to the laboratory for analysis during the Parcel C Phase II project area removal action. No ROC concentrations above the release criteria specified in the AM (DON 2006) or the remediation goals established in the ROD (DON 2010) were identified in the TU315 FSS soil sample analytical results. The release criteria are identified in Tables 2-1 and 2-3, and the remediation goals are presented in Table 2-2. Figure 5-1

depicts the FSS soil sample collection locations in TU315. The gamma scan ranges and static measurement values were presented in Attachment 1 to the TU315 SUPR provided in Appendix D. The laboratory analytical reports for the FSS soil samples were included in Attachment 3 to the TU315 SUPR.

For the FSS, TU315 was defined as the sum of the trench unit and the backfill materials composed of both radiologically processed and released excavated soil survey units and a volume of imported fill. The average net residual ROC concentrations for materials used as backfill in TU315 were 0.021 pCi/g for Cs-137, 0.154 pCi/g for Sr-90, and -0.074 pCi/g for Ra-226. The trench unit average net residual ROC concentrations were 0.021 pCi/g for Cs-137, 0.148 pCi/g for Sr-90, and -0.007 pCi/g for Ra-226. The net Ra-226 concentration (with background Ra-226 subtracted) was used to calculate dose and risk. No background was subtracted from the Cs-137 or Sr-90 values since these radionuclides were not naturally occurring or expected due to nuclear weapons testing fallout at pipe depths.

RESRAD modeling using the larger of the MDL or net residual ROC and their decay product concentrations resulted in a dose of 0.6449 mrem/y with an increased cancer risk of 8.305×10^{-6} for the backfill material and 0.6214 mrem/y with an increased cancer risk of 8.008×10^{-6} for the trench unit (Yu et. al. 2001). These results were less than the NRC criterion of 25 mrem/y and the increased cancer risk falls within the EPA risk management range of 10^{-6} to 10^{-4} . The modeling parameters, values, and results were presented in Attachments 7 and 8 to the TU315 SUPR (Appendix D).

The results of the modeling efforts determined that the potential TU315 dose due to the net residual ROC and their decay products at concentrations greater than or equal to the MDL was 0.6449 mrem/y with an increased cancer risk of 8.305×10^{-6} , which supports radiological free release. Qualitative ALARA analyses resulted in: 1) no FSS gamma survey measurements above the investigation levels, 2) none of the FSS sample had net residual ROC concentrations above the release criteria, 3) no air monitoring results exceeded 10 percent of the derived air concentrations for members of the public, and 4) no personnel dosimetry badges processed identified doses above background levels. No further radiological action was recommended in the TU315 SUPR (Appendix D). Table 3-1 summarizes the activities performed during the Parcel C Phase II project area removal action to support the recommended radiological free release of TU315.

5.1.4 TU315 Backfill Activities

Radiologically processed and released excavated soil survey units and a volume of imported fill were selected as the backfill materials for TU315. The excavated soil survey units selected as backfill material included:

- ES-770

- ES-773

Radiological information related to the processing of these excavated soil survey units is summarized in Table 3-4 and the associated laboratory analytical results are discussed in the TU315 SUPR (Appendix D). The radiological and chemical analytical reports for the imported fill are provided in Appendix K.

The ~~RASO-DON~~ concurred with backfilling TU315 on April 30, 2013. Backfill operations commenced on May 22, 2013 and were completed on June 3, 2013. An estimated 1,567 cubic yards of soil was placed in TU315 to grade followed by the application of road base material over the backfilled trench. Backfill activities were performed in accordance with the HPNS Basewide Construction Specifications (TtEC 2012e). Parcel C Phase II project area restoration activities are described in Section 9.0.

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5.2 TRENCH SURVEY UNIT 316

Physically separated into three distinct sections, TU316 is located in the southeast portion of Work Area 33 within Parcel C (Figures 3-1 and 5-1). One section of TU316 is located at the northeast end of Buildings 270 and 273 and south of Building 281. The second section is located adjacent to the east side of Building 270 and north of Nimitz Avenue. The third section of TU316 originates on Nimitz Avenue and extends southwest toward Ship Berth 4. The majority of TU316 is situated within IR Program Site IR-28. The chemicals of concern associated with IR-28 are listed in Table 3-9.

TU316 is composed of eight storm drain trench segments and nine sanitary sewer trench segments. As identified on Figure 5-1 and Table 3-1, these trench segments include:

Storm Drain Trench Segments

- 12-C33-00-4R
- 12-C33-00-4T
- 12-C33-00-4U
- 12-C33-28-3O
- 12-C33-28-3P
- 12-C33-28-3Q
- 12-C33-28-3R
- 12-C33-28-8C

Sanitary Sewer Trench Segments

- 12-C33-28-2Y
- 12-C33-28-2Z
- 12-C33-28-3A
- 12-C33-28-3B
- 12-C33-28-3L
- 12-C33-28-3M
- 12-C33-28-3N
- 12-C33-28-8A
- 12-C33-28-8B

Sanitary sewer trench segments 12-C33-28-3A and 12-C33-28-3L transition into TU317 on the west and 12-C33-28-3L extends into TU315 on the east. Sanitary sewer trench segment 12-C33-28-3M continues into TU317 on the west. Sanitary sewer trench segment 12-C33-28-3N and storm drain trench segments 12-C33-28-3O and -3Q transition into TU315 on the east. Sanitary sewer trench segment 12-C33-28-8A continues into TU317 on the south. With the exception of 12-C33-28-8A, -8B, and -8C, each of the trench segments associated with TU316 was identified in the Design Plan (TtEC2012d). Sanitary sewer trench segment 12-C33-28-8A was found during excavation of manhole MH1106 and TU317. Sanitary sewer trench segment 12-C33-28-8B and storm drain trench segment 12-C33-28-8C were found during excavation of trench segment 12-C33-28-2Y.

5.2.1 TU316 Removal Action Activities

Excavation activities for TU316 were initiated on January 25, 2013 in sanitary sewer trench segment 12-C33-28-2Y. A total of 65 truckloads of soil (approximately 780 cubic yards) were excavated from TU316 during the Parcel C Phase II project area removal action (Table 3-3). Soil generated during excavation of TU316 was transferred to both RSY3 and RSY4 for radiological processing (Table 3-4). Following completion of the excavation on February 11, 2013, TU316 exhibited an exposed surface area of 994 m² and was 557 linear feet in length (Table 3-1). The maximum excavated TU316 depths ranged between 5 feet and 8 feet bgs (Table 3-2).

A total of five manholes (MH961, MH963, MH964, MH1106, and MH1343) and four sections of pipe were removed from TU316 during the Parcel C Phase II project area removal action and placed on plastic pending further activities (Figure 5-1). The majority of the TU316 piping disintegrated upon removal and the debris was transferred along with the surrounding excavated soil to either RSY3 or RSY4 for radiological processing. As indicated in Table 3-2, storm drain trench segments 12-C33-00-4R, 12-C33-28-3P, and 12-C33-28-8C contained 6-inch-diameter VCP located at depths between 6 feet and 8 feet bgs. Storm drain trench segments 12-C33-00-4T, 12-C33-28-3Q, and 12-C33-28-3R contained 10-inch-diameter VCP located at depths between 5 feet and 7 feet bgs. Storm drain trench segment 12-C33-00-4U contained 4-inch-diameter steel pipe located at a depth of approximately 5 feet bgs and 12-C33-28-3O contained 12-inch-diameter VCP located at a depth of about 7 feet bgs. Sanitary sewer trench segment 12-C33-28-2Z contained 4-inch-diameter VCP located at a depth of approximately 6 feet bgs and sanitary sewer trench segment 12-C33-28-3L contained 18-inch-diameter RCP located at depths between 6 feet and 7 feet bgs. The remainder of the trench segments contained 6-inch-diameter or 8-inch-diameter VCP located at depths between 5 feet and 8 feet bgs (Table 3-2).

A sufficient volume of sediment was available for sample collection and analysis in manholes MH961 (sample 12-PCMH961-006-01) and MH963 (sample 12-PCMH963-005-01) during the Parcel C Phase II project area removal action (Table 3-5). No ROC concentrations above the release criteria were identified by the laboratory analytical results for the sediment sample collected from

MH961. The analytical results for the sediment sample collected from MH963 identified the presence of Ra-226 above the release criterion at 1.581 pCi/g. Based on this result, the brick materials forming manhole MH963 were placed in LLRW bin MHFU001109T19 on February 4, 2013 for off-site disposal by the DON radiological waste contractor. The sediment sample laboratory analytical reports are provided in Appendix I.

Radiological survey activities were performed for manholes MH961, MH964, MH1106, and MH1343 (survey HPS-PCPIPE-031913-071) and three sections of pipe removed from trench segment 12-C33-28-3L (survey HPS-PCPIPE-020413-066) during the Parcel C Phase II removal action activities (Table 3-6). No elevated survey results were identified for manhole MH1343 or the three sections of pipe removed from trench segment 12-C33-28-3L. Based on these results, the brick materials forming MH1343 and the three sections of trench segment 12-C33-28-3L pipe was released and the debris transferred to the DON non-radiological waste contractor for off-site disposal or recycling. The survey results for manholes MH961, MH964, and MH1106 identified net beta/gamma static measurements ranging from 1,037 dpm/100 cm² to 1,262 dpm/100 cm². Based on these results, the brick materials forming manholes MH961, MH964, and MH1106 were placed in LLRW bins GFLU001215T18, MHFU001131T2, and GFLU001295T13 in March 2013 for off-site disposal by the DON radiological waste contractor. The one section of 4-inch-diameter steel pipe removed from trench segment 12-C33-00-4U was placed in LLRW bin GFLU001212T18 on March 14, 2013 because it was too narrow in diameter to properly survey. Copies of the radiological survey reports are presented in Appendix J.

Initially, four investigative soil samples were collected from the bottom of TU316 on March 8, 2013 due to the Ra-226 contamination identified in the sediment sample collected from MH963. The analytical results for the investigative soil samples did not identify the presence of ROC concentrations above the release criteria. Based on these results, 18 systematic soil samples were collected from the exposed sidewalls and bottom of TU316 on March 20, 2103 and submitted to the laboratory for screening analysis. The screening analytical results identified the presence of Ra-226 activity concentrations in three soil samples at 1.555 pCi/g, 1.876 pCi/g, and 1.985 pCi/g; however, these results were less than the Ra-226 release limit for NORM fill material (Table 2-4). The screening laboratory analytical results were presented in Attachment 2 to the TU316 SUPR provided in Appendix D.

Due to the presence of Ra-226 levels above the release criterion and since the NORM Abstract (Appendix A) release limit had not yet been approved, approximately 12.5 cubic yards of soil was removed from trench segments 12-C33-28-3A, -8B, and -8C on April 2, 2013 and placed in LLRW bin GFLU002088T1 (Table 3-8) for off-site disposal by the DON radiological waste contractor. Following the remediation efforts, a total of nine verification soil samples were collected and analyzed. The screening laboratory analytical results identified the presence of Ra-226 activity concentrations above the release limit in six soil samples ranging from 1.747 pCi/g to 2.138 pCi/g.

However, with the application of the NORM Abstract (Appendix A) Ra-226 release limit, only two soil samples exceeded the release criterion (Table 2-4). Based on these results, an estimated 16 cubic yards of soil was removed from trench segments 12-C33-28-3A, -8B, and -8C on April 12, 2013 and placed in LLRW bins GFLU001165T20 and GFLU002154T2 for off-site disposal by the DON radiological waste contractor. Following the remediation efforts, nine verification soil samples were collected on April 16, 2013 and submitted to the laboratory for analysis. Ra-226 activity concentrations above the release limit were identified in the analytical results for six of the soil samples ranging from 1.67 pCi/g to 2.33 pCi/g. However, with the application of the NORM Abstract release limit for Ra-226, only two soil samples exceeded the release limit (Table 2-4). In addition one investigative soil sample was collected and analyzed to determine the presence of NORM fill material in TU316. The DON concluded that the persistence of relatively elevated Ra-226 activity was likely due to the presence of NORM fill materials as described in Section 2.5.8. For consistency, a replacement verification soil was collected from the adjacent NORM fill material in TU316 and analyzed. No ROC concentrations above the release limits were identified in the analytical results for this verification soil sample. Figure 5-2 depicts the approximate locations of the Ra-226 soil samples in TU316 associated with the NORM fill materials.

The eight verification soil samples were submitted to the laboratory for definitive analysis. The definitive analytical results did not identify the presence of Ra-226 concentrations above the NORM Abstract release limit (Table 2-4). Regardless, two replacement verification soil samples were collected on July 3, 2013 and submitted to the laboratory for analysis. A Ra-226 concentration above the NORM Abstract release limit was identified in soil sample at 2.199 pCi/g. Based on this result, one replacement verification soil sample was collected and submitted to the laboratory for analysis on July 15, 2013. The analytical results for this verification soil sample identified the presence of Ra-226 above the NORM Abstract release limit at 2.182 pCi/g. Based on these results, approximately 33.5 cubic yards of soil was removed from TU316 and placed in LLRW bins GFLU001190T13, CVGU002035T3, GFLU001181T2, and GFLU002035T3 on July 26, 2013 for off-site disposal by the DON radiological waste contractor (Table 3-8).

Following the remediation efforts, three verification soil samples were collected from TU316 on July 29, 2013 and submitted to the laboratory for analysis. The analytical results identified the presence of Ra-226 radioactivity concentrations above the NORM Abstract (Appendix A) release limit in one soil sample at 2.898 pCi/g. Based on this result, approximately 9 cubic yards of soil was removed from TU316 on September 9, 2013 and placed in LLRW bins GFLU001209T18 and GFLU001235T17 (Table 3-8). A total of six verification soil samples were collected and analyzed following the remediation event. The analytical results identified the presence of Ra-226 activity concentrations above the NORM Abstract release limit in two of the verifications soil samples at 2.206 pCi/g and 2.193 pCi/g. Based on these results, an estimated 30.5 cubic yards of soil was removed from TU316 on October 21- 2013 and placed in five LLRW bins for off-site disposal by the DON radiological waste contractor (Table 3-8). Following the remediation efforts, six

verification soil samples were collected and analyzed. None of the analytical results identified the presence of Ra-226 activity concentrations above the release limit for NORM fill material (Table 2-4). Figure 5-2 depicts the approximate locations of the Ra-226 soil samples in TU316 associated with the NORM fill materials.

By applying the NORM Abstract release criteria (Appendix A), only 8 of the 41 soil samples (investigative and verification) collected from TU316 and submitted to the laboratory for analysis identified the presence of Ra-226 radioactivity concentrations above the release limit (Table 2-4) ranging from 1.206 pCi/g to 2.898 pCi/g. Based on these results, an estimated 101.5 cubic yards of soil was removed from TU316 and placed in LLRW bins for off-site disposal by the DON radiological waste contractor (Table 3-8).

5.2.2 TU316 Piping Remaining in Place

No known storm drain or sanitary sewer systems piping associated with TU316 remained in place within Parcel C following completion of the Phase II time-critical removal action activities.

5.2.3 TU316 Final Status Survey Summary

The 18 systematic soil samples collected from the exposed sidewalls and bottom of TU316 on March 20, 2013 were submitted to the laboratory for definitive analysis during the Parcel C Phase II project area removal action. No ROC concentrations above the release criteria specified in the NORM Abstract (Appendix A) were identified in the TU316 FSS soil sample analytical results. The NORM Abstract release criteria are specified in Table 2-4. Figure 5-1 depicts the FSS soil sample collection locations in TU316. The range in the gamma scan survey s and static survey count rates were presented in Attachment 1 to the TU316 SUPR provided in Appendix D. The definitive laboratory analytical reports for the FSS soil samples were included in Attachment 3 to the TU316 SUPR (Appendix D).

TU316 was defined for the FSS as the sum of the trench unit and the backfill materials composed of a volume of imported fill. The average net residual ROC concentrations for materials used as backfill were 0.020 pCi/g for Cs-137, 0.152 pCi/g for Sr-90, and -0.141 pCi/g for Ra-226. The trench unit average net residual ROC concentrations were 0.022 pCi/g for Cs-137, 0.254 pCi/g for Sr-90, and -0.422 pCi/g for Ra-226. The net Ra-226 concentration (with background Ra-226 subtracted) was used to calculate dose and risk. No background was subtracted from the Cs-137 or Sr-90 values since these radionuclides were not naturally occurring or expected due to nuclear weapons testing fallout at pipe depths.

RESRAD modeling using the larger of the MDL or reported net residual ROC and their decay product concentrations resulted in a dose of 0.6518 mrem/y with an increased cancer risk of 8.385×10^{-6} for the backfill material and 1.067 mrem/y with an increased cancer risk of 1.364×10^{-6} for the trench unit (Yu et. al. 2001). These results were less than the NRC criterion of 25 mrem/y and

the increased cancer risk falls within the EPA risk management range of 10^{-6} to 10^{-4} . The modeling parameters, values, and results were presented in Attachments 4 and 5 to the TU316 SUPR (Appendix D).

The results of the modeling efforts determined that the potential TU316 dose due to net residual ROC and their decay product concentrations greater than or equal to the MDL was 1.067 mrem/y with an increased cancer risk of 1.364×10^{-5} , which supports radiological free release. Qualitative ALARA analyses resulted in: 1) no FSS gamma survey measurements above the investigation levels, 2) none of the FSS samples had net residual ROC concentrations above the release criteria specified in Table 2-4, 3) no air monitoring results exceeded 10 percent of the derived air concentration for members of the public, and 4) no personnel dosimetry badges processed identified doses above background levels. No further radiological action was recommended in the TU316 SUPR (Appendix D). Table 3-1 summarizes the activities performed during the Parcel C Phase II project area removal action to support the recommended radiological free release of TU316.

5.2.4 TU316 Backfill Activities

A volume of imported fill was selected as the appropriate backfill material for TU316. The radiological and chemical analytical reports for the imported fill are provided in Appendix K.

With the concurrence of the DON on December 9, 2013, backfill operations were initiated on December 0, 2013 and completed on December 13, 2013. An estimated 1,112 cubic yards of imported fill was placed in TU36 to grade followed by the application of road base material over the backfilled trench. Backfill activities were performed in accordance with the HPNS Basewide Construction Specifications (TtEC 2012e). Parcel C Phase II project area site restoration activities are described in Section 9.0.

5.3 TRENCH SURVEY UNIT 317

Physically separated into three distinct sections, TU317 is located in the southern portion of Work Area 33 within Parcel C (Figures 3-1 and 5-1). The largest section of TU317 is situated along Nimitz Avenue and connects to TU316 on the north and east and TU318 on the west. One section of TU317 is located west of Building 270 with a portion extending northwest toward Building 217. The smallest section of TU317 originates at the northwest corner of Building 271 and connects to TU232. The three sections of TU317 are situated within IR Program Site IR-28. The chemicals of concern associated with IR-28 are listed in Table 3-9.

TU317 is composed of two storm drain trench segments and five sanitary sewer trench segments. As identified on Figure 5-1 and Table 3-1, these trench segments include:

Storm Drain Trench Segments

Sanitary Sewer Trench Segments

- 12-271-28-2U
- 12-C33-28-2U
- 12-C33-28-3A
- 12-C33-28-3J
- 12-C33-28-3L
- 12-C33-28-3M
- 12-C33-28-8A

Trench segments 12-C33-28-3A, -3L, -3M, and -8A transition into TU316 on the east and trench segments 12-C33-28-3J and -3L extend into TU318 on the west. With the exception of sanitary sewer trench segment 12-C33-28-8A, each of the trench segments associated with TU317 was identified in the Design Plan (TtEC 2012d). Trench segment 12-C33-28-8A was found during excavation of Manhole MH962.

5.3.1 TU317 Removal Action Activities

Excavation activities for TU317 were initiated on January 22, 2013 in trench segment 12-C33-28-3J. A total of 58 truckloads of soil (approximately 696 cubic yards) were excavated from TU317 during the Parcel C Phase II project area removal action (Table 3-3). Soil generated during excavation of TU317 was transferred to both RSY3 and RSY4 for radiological processing (Table 3-4). Following completion of the excavation on February 12, 2013, TU317 exhibited an exposed surface area of 947 m² and was 510 linear feet in length (Table 3-1). The maximum excavated TU317 depths ranged between 3 feet and 9 feet bgs (Table 3-2).

Manhole MH962 and eight sections of pipe were removed from TU317 during the Parcel C Phase II project area removal action and placed on plastic pending further activities (Figure 5-1). The majority of the TU317 piping disintegrated during removal and the debris was transferred along with the surrounding excavated soil to RSY3 or RSY4 for radiological processing. As indicated in Table 3-2, storm drain trench segments 12-271-28-2U and 12-C33-28-2U contained 4-inch-diameter VCP located at depths ranging from 2 feet to 6 feet bgs. Sanitary sewer trench segment 12-C33-28-3A contained 6-inch diameter VCP located at a depth of approximately 7 feet bgs. Sanitary sewer trench segment 12-C33-28-3L contained 18-inch-diameter RCP located at a depth of about 7 feet bgs. The remaining trench segments contained 8-inch-diameter VCP located at depths between 6 feet and 7 feet bgs.

A sufficient volume of sediment was available for sample collection and analysis in Manhole MH962 (sample 12-PCMH962-004-01) during the Parcel C Phase II project area removal action (Table 3-5). The laboratory analytical results identified the presence of Ra-226 contamination in the sediment sample collected from Manhole MH962 with 2.065 pCi/g. The concrete materials forming Manhole MH962 were placed in LLRW bin GFLU001189T17 on February 13, 2013 pending transfer to the DON radiological waste contractor for off-site disposal. The analytical results for the sediment sample collected from Manhole MH962 are provided in Appendix I.

Radiological survey activities were performed for the eight sections of pipe removed from trench segment 12-C33-28-3L (Table 3-6). No elevated results were identified for the TU317 piping surveyed. Based on these results, the eight sections of trench segment 12-C33-28-3L RCP were released and the debris transferred to the DON non-LLRW contractor for off-site disposal or recycling. A copy of the radiological survey report is presented in Appendix J.

Initially, a total of 20 investigative soil samples were collected from the exposed bottom of TU317 on March 8, 2013 and submitted to the laboratory for analysis due to the presence of Ra-226 contamination in the Manhole MH962 sediment sample analytical results (Tables 3-1 and 3-5). No ROC concentrations exceeding the release criteria were identified in the investigative soil sample analytical results. The laboratory analytical results were provided in Attachment 2 to the TU317 SUPR provided in Appendix D.

5.3.2 TU317 Piping Remaining in Place

A total of 15 linear feet of storm drain trench segment 12-271-28-2U 4-inch-diameter VCP was excavated prior to being terminated near the Building 271 foundation during the Parcel C Phase II project area removal action activities. Based on historical drawings, an estimated 60 linear feet of trench segment 12-271-28-2U remained in place beneath Building 271 to preserve the integrity of the structure (Table 3-7). To ensure that no residual radioactivity above the release criteria was associated with the 60 linear feet of pipe remaining in place, radiological survey activities were performed on February 7, 2013 at both the northwest and southwest ends of the pipe remaining in place (HPS-PCPIPE-012813-065). No elevated results were identified at either ends of the pipe remaining in place beneath Building 271. Based on these results, the DON concluded that the 60 feet of pipe remaining in place was unlikely to be contaminated. A copy of the survey report is provided in Appendix J.

5.3.3 TU317 Final Status Survey Summary

During the FSS activities, a total of 18 systematic soil samples were collected from the exposed sidewalls and bottom of TU317 on April 1, 2013 and submitted to the laboratory for analysis during the Parcel C Phase II project area removal action. No ROC concentrations above the release criteria specified in the AM (DON 2006) or the remediation goals established in the ROD (DON 2010) were identified in the TU317 FSS soil sample analytical results. The release criteria are identified in Tables 2-1 and 2-3, and the remediation goals are presented in Table 2-2. Figure 5-1 depicts the FSS soil sample collection locations in TU317. The gamma scan ranges and static measurement values were presented in Attachment 1 to the TU317 SUPR provided in Appendix D. The laboratory analytical reports for the FSS soil samples were included in Attachment 3 to the TU317 SUPR.

For the FSS, TU317 was defined as the sum of the trench unit and the backfill materials composed of both radiologically processed and released excavated soil survey units and a volume of imported

fill. The average net residual ROC concentrations for materials used as backfill in TU317 were 0.021 pCi/g for Cs-137, 0.157 pCi/g for Sr-90, and -0.121 pCi/g for Ra-226. The trench unit average net residual ROC concentrations were 0.019 pCi/g for Cs-137, 0.183 pCi/g for Sr-90, and -0.073 pCi/g for Ra-226. The net Ra-226 concentration (with background Ra-226 subtracted) was used to calculate dose and risk. No background was subtracted from the Cs-137 or Sr-90 values since these radionuclides were not naturally occurring or expected due to nuclear weapons testing fallout at pipe depths.

RESRAD modeling using the larger of the MDL or net residual ROC and their decay product concentrations resulted in a net residual dose of 0.6439 mrem/y with an increased cancer risk of 8.292×10^{-6} for the backfill material and 0.7397 mrem/y with an increased cancer risk of 9.488×10^{-6} for the trench unit (Yu et. al. 2001). These results were less than the NRC criterion of 25 mrem/y and the increased cancer risk falls within the EPA risk management range of 10^{-6} to 10^{-4} . The modeling parameters, values, and results were presented in Attachments 7 and 8 to the TU317 SUPR (Appendix D).

The results of the modeling efforts determined that the potential TU317 dose due to net residual ROC and their decay product concentrations greater than or equal to the MDL was 0.7397 mrem/y with an increased cancer risk of 9.488×10^{-6} , which supports radiological free release. Qualitative ALARA analyses resulted in: 1) no FSS gamma survey measurements above the investigation levels, 2) none of the FSS sample results identified net residual ROC concentrations above the release criteria, 3) no air monitoring results exceeded 10 percent of the derived air concentration for members of the public, and 4) no personnel dosimetry badges processed identified doses above background levels. No further radiological action was recommended in the TU317 SUPR (Appendix D). Table 3-1 summarizes the activities performed during the Parcel C Phase II project area removal action to support the recommended radiological free release of TU317.

5.3.4 TU317 Backfill Activities

Radiologically processed and released excavated soil survey units and a volume of imported fill were selected as the backfill materials for TU317. The excavated soil survey units selected as backfill material included:

- ES-788
- ES-801

Radiological information related to the processing of these excavated soil survey units is summarized in Table 3-4 and the associated laboratory analytical results are discussed in the TU317 SUPR (Appendix D). The radiological and chemical analytical reports for the imported fill are provided in Appendix K.

The ~~RASO-DON~~ concurred with backfilling TU317 on June 12, 2013 and backfill operations commenced the following day. Backfill activities for TU317 were completed on June 27, 2013. An estimated 1,032 cubic yards of soil was placed in TU317 to grade followed by the application of road base material over the backfilled trench. Backfill activities were performed in accordance with the HPNS Basewide Construction Specifications (TtEC 2012e). Parcel C Phase II project area restoration activities are described in Section 9.0.

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5.4 TRENCH SURVEY UNIT 318

TU318 is located in the southwest portion of Work Area 33 along Nimitz Avenue within Parcel C and between Building 272 and Building 230 (Figures 3-1 and 5-1). The east end of TU318 is situated within IR Program Site IR-28. The chemicals of concern associated with IR-28 are listed in Table 3-9.

TU318 is composed of four storm drain trench segments and eight sanitary sewer trench segments. As identified on Figure 5-1 and Table 3-1, these trench segments include:

Storm Drain Trench Segments

- 12-C33-00-4F
- 12-C33-00-4G
- 12-C33-00-4H
- 12-C33-28-3K

Sanitary Sewer Trench Segments

- 12-C33-00-3T
- 12-C33-00-4E
- 12-C33-00-4I
- 12-C33-00-4K
- 12-C33-28-2X
- 12-C33-28-3I
- 12-C33-28-3J
- 12-C33-28-3L

Storm drain trench segment 12-C33-00-4F and sanitary sewer trench segments 12-C33-00-4E and -4K transition into TU319 on the west. Sanitary sewer trench segment 12-C33-28-3J continues into TU317 on the east. Sanitary sewer trench segment 12-C33-28-3L extends into TU319 on the west and TU317 on the east. Each of the trench segments associated with TU318 was identified in the Design Plan (TtEC 2012d).

5.4.1 TU318 Removal Action Activities

Excavation activities for TU318 were initiated on January 16, 2013 in trench segments 12-C33-00-4F and -4G. A total of 191 truckloads of soil (approximately 2,292 cubic yards) were excavated from TU318 during the Parcel C Phase II project area removal action (Table 3-3). Soil generated during excavation of TU318 was transferred to both RSY3 and RSY4 for radiological processing (Table 3-4). Following completion of the excavation on February 20, 2013, TU318 exhibited an

exposed surface area of 892 m² and was 420 linear feet in length (Table 3-1). The maximum excavated TU318 depths ranged between 2 feet and 9 feet bgs (Table 3-2).

Manholes MH959 and MH960 and seven sections of pipe were removed from TU318 during the Parcel C Phase II project area removal action and placed on plastic pending further activities (Figure 5-1). The majority of the TU318 piping disintegrated upon removal and the debris was transferred along with the surrounding excavated soil to either RSY3 or RSY4 for radiological processing. As indicated in Table 3-2, sanitary sewer trench segments 12-C33-00-3T, 12-C33-28-2X, and 12-C33-28-3I contained 6-inch-diameter VCP located at depths between 5 feet and 6 feet bgs. Sanitary sewer trench segments 12-C33-00-4E and 12-C33-28-3J contained 8-inch-diameter VCP located at depths between 7 feet and 8 feet bgs and 12-C33-00-4I contained 4-inch-diameter VCP located at a depth of approximately 5 feet bgs. Sanitary sewer trench segments 12-C33-00-4K and 12-C33-28-3L contained 21-inch-diameter and 18-inch-diameter, respectively, RCP located at depths between 6 feet and 7 feet bgs. Storm drain trench segment 12-C33-00-4H and 12-C33-28-3K contained 8-inch-diameter VCP located at a depth of approximately 7 feet bgs. Storm drain trench segment 12-C33-00-4F contained 15-inch-diameter VCP located at a depth of approximately 7 feet bgs and 12-C33-00-4G contained 4-inch-diameter VCP located at a depth of about 2 feet bgs (Table 3-2).

As indicated in Table 3-5, a sufficient volume of sediment was available for sample collection and analysis in one section of pipe removed from trench segment 12-C33-00-4K (sample 12-PCPI-0009-01) and one section of pipe removed from trench segment 12-C33-28-3L (sample 12-PCPI-0010-01). No ROC concentrations above the release criteria were identified by the laboratory analytical results for either of the two sediment samples. The sediment sample laboratory analytical reports are provided in Appendix I.

Radiological survey activities were performed for manholes MH959 and MH960 (survey HPS-PCPIPE-012413-064), five sections of pipe removed from trench segment 12-C33-00-4K (survey HPS-PCPIPE-020513-068), and two sections of pipe removed from trench segment 12-C33-28-3L (survey HPS-PCPIPE-020413-066) (Table 3-6). None of the survey results identified the presence of elevated measurements. Based on these results, the brick materials forming the two manholes and the seven sections of pipe were released and the debris transferred to the DON non-LLRW contractor for off-site disposal or recycling. Copies of the radiological survey reports are presented in Appendix J.

Initially, 25 investigative soil samples were collected from the bottom of TU318 due to the presence of Ra-226 contamination at 1.58 pCi/g in a sediment sample collected from manhole MH963 in adjacent TU316. The analytical results for the investigative soil samples did not identify the presence of ROC concentrations above the release criteria. A total of 18 systematic soil samples were collected from the exposed sidewalls and bottom of TU318 on March 14, 2013 and

submitted to the laboratory for screening analysis. The analytical results identified the presence of Ra-226 above the SUPR Abstract release criterion at 1.994, but below the NORM Abstract (Appendix A) release criterion (Table 2-4). Based on this result, approximately 2 cubic yards of soil was removed from trench segment 12-C33-00-4H and placed in LLRW bin GFLU001189T2 for off-site disposal by the DON radiological waste contractor (Table 3-8). Following the remediation efforts, three verification soil samples were collected and analyzed. The analytical results identified the presence of Ra-226 above the SUPR Abstract release criterion at 1.893 pCi/g and 1.962 pCi/g, but below the NORM Abstract (Appendix A) release criterion (Table 2-4). Based on these results, approximately 5 cubic yards of soil was removed from trench segment 12-C33-00-4H on April 12, 2013 and placed in LLRW bin GFLU0011168T2 for off-site disposal by the DON radiological waste contractor (Table 3-8). Following the remediation efforts, three verification soil samples were collected and analyzed. None of the verification soil sample analytical results identified the presence of ROC concentrations above the release criteria. Figure 5-2 depicts the locations of the Ra-226 soil samples associated with the NORM fill material.

5.4.2 TU318 Piping Remaining in Place

No known storm drain or sanitary sewer systems piping associated with TU318 remained in place within Parcel C following completion of the Phase II time-critical removal action activities.

5.4.3 TU318 Final Status Survey Summary

Eighteen systematic soil samples were collected from the exposed sidewalls and bottom of TU318 on April 24, 2013 and submitted to the laboratory for definitive analysis during the Parcel C Phase II project area removal action. No ROC concentrations above the release criteria specified in the NORM Abstract (Appendix A) were identified in the TU318 FSS soil sample analytical results for the . The NORM Abstract release criteria are specified in Table 2-4. Figure 5-1 depicts the FSS soil sample collection locations in TU318. The range in the gamma scan surveys and static survey count rates were presented in Attachment 1 to the TU318 SUPR provided in Appendix D. The definitive laboratory analytical reports for the FSS soil samples were included in Attachment 3 to the TU318 SUPR (Appendix D).

For the FSS, TU318 was defined as the sum of the trench unit and the backfill materials composed of both radiologically processed and released excavated soil survey units and a volume of imported fill. The average net residual ROC concentrations for materials used as backfill were 0.021 pCi/g for Cs-137, 0.179 pCi/g for Sr-90, and -0.009 pCi/g for Ra-226. The trench unit average net residual ROC concentrations were 0.022 pCi/g for Cs-137, 0.137 pCi/g for Sr-90, and 0.133 pCi/g for Ra-226. The net Ra-226 concentration (with background Ra-226 subtracted) was used to calculate dose and risk. No background was subtracted from the Cs-137 or Sr-90 values since these radionuclides were not naturally occurring or expected due to nuclear weapons testing fallout at pipe depths.

RESRAD modeling using the larger of the MDL or reported net residual ROC and their decay product concentrations resulted in a dose of 0.6883 mrem/y with an increased cancer risk of 8.852×10^{-6} for the backfill material and 2.668 mrem/y with an increased cancer risk of 4.136×10^{-5} for the trench unit (Yu et. al. 2001). These results were less than the NRC criterion of 25 mrem/y and the increased cancer risk falls within the EPA risk management range of 10^{-6} to 10^{-4} . The modeling parameters, values, and results were presented in Attachments 7 and 8 to the TU318 SUPR (Appendix D).

The results of the modeling efforts determined that the potential TU318 dose due to net residual ROC and their decay product concentrations greater than or equal to the MDL was 2.668 mrem/y with an increased cancer risk of 4.136×10^{-5} , which supports radiological free release. Qualitative ALARA analyses resulted in: 1) no FSS gamma survey measurements above the investigation levels, 2) none of the FSS sample results identified net residual ROC concentrations above the release criteria specified in Table 2-4, 3) no air monitoring results exceeded 10 percent of the derived air concentration for members of the public, and 4) no personnel dosimetry badges processed identified doses above background levels. No further radiological action was recommended in the TU318 SUPR (Appendix D). Table 3-1 summarizes the activities performed during the Parcel C Phase II project area removal action to support the recommended radiological free release of TU318.

5.4.4 TU318 Backfill Activities

Radiologically processed and released excavated soil survey units and a volume of imported fill were selected as the backfill materials for TU318. The excavated soil survey units selected as backfill material included:

- ES-819
- ES-820
- ES-821

Radiological information related to the processing of these excavated soil survey units is summarized in Table 3-4 and the associated laboratory analytical results were discussed in the TU318 SUPR (Appendix D). The radiological and chemical analytical reports for the imported fill are provided in Appendix K.

With the concurrence of the DON, backfill operations were initiated on October 28, 2013 and were completed on October 30, 2013. An estimated 1,021 cubic yards of soil was placed in TU318 to grade followed by the application of road base material over the backfilled trench. Backfill activities were performed in accordance with the HPNS Basewide Construction Specifications (TtEC 2012e). Parcel C Phase II project area site restoration activities are described in Section 9.0.

5.5 TRENCH SURVEY UNIT 319

TU319 is located in the southwest corner of Work Area 33 within Parcel C along Nimitz Avenue and south of non-radiologically impacted Building 203 (Figures 3-1 and 5-1). TU319 connects to TU232 on the north, TU318 on the east, TU320 on the south, and TU 330 on the west. The majority of TU319 is situated within IR Program Sites IR-28 and IR-29. The chemicals of concern associated with IR-28 and IR-29 are listed in Table 3-9.

TU319 is composed of 5 storm drain trench segments and 15 sanitary sewer trench segments. As identified on Figure 5-1 and Table 3-1, these trench segments include:

<u>Storm Drain Trench Segments</u>	<u>Sanitary Sewer Trench Segments</u>
<ul style="list-style-type: none">• 12-C33-00-3S• 12-C33-00-4B• 12-C33-00-4F• 12-C33-00-4L• 12-C33-29-2H	<ul style="list-style-type: none">• 12-C33-00-3K• 12-C33-00-4A• 12-C33-00-4C• 12-C33-00-4D• 12-C33-00-4E• 12-C33-00-4J• 12-C33-00-4K• 12-C33-00-4M• 12-C33-00-4V• 12-C33-28-3H• 12-C33-29-1Z• 12-C33-29-2D• 12-C33-29-2E• 12-C33-29-2F• 12-C33-29-2I

Trench segments 12-C33-00-4E, -4F, and -4K transition into TU318 on the east. Trench segment 12-C33-00-4M continues into TU320 on the south and trench segment 12-C33-29-2H extends into TU330 on the west. Each of the trench segments associated with TU319 was identified in the Design Plan (TtEC 2012d).

5.5.1 TU319 Removal Action Activities

Excavation activities for TU319 were initiated on January 11, 2013 in trench segment 12-C33-29-2I. A total of 132 truckloads of soil (approximately 1,584 cubic yards) were excavated from

TU319 during the Parcel C Phase II project area removal action (Table 3-3). Soil generated during excavation of TU319 was transferred to RSY4 for radiological processing (Table 3-4). Following completion of the excavation on March 4, 2013, TU319 exhibited an exposed surface area of 852 m² and was 366 linear feet in length (Table 3-1). The maximum excavated TU319 depths ranged between 3 feet and 12 feet bgs (Table 3-2).

Manholes MH938, MH939, MH955, MH956, MH957, and MH958 and six sections of pipe were removed from TU319 during the Parcel C Phase II project area removal action and placed on plastic pending further activities (Figure 5-1). The majority of the TU319 piping disintegrated during removal and the debris was transferred along with the surrounding excavated soil to RSY4 for radiological processing. As indicated in Table 3-2, storm drain trench segment 12-C33-00-3S contained 10-inch-diameter steel pipe located at depths between 7 feet and 8 feet bgs. Storm drain trench segments 12-C33-00-4B, 12-C33-00-4F, and 12-C33-29-2H contained 15-inch-diameter VCP located at depths ranging from 5 feet to 7 feet bgs and 12-C33-4L contained 10-inch-diameter VCP located at an approximate depth of 9 feet bgs. Sanitary sewer trench segment 12-C33-00-4C, 12-C33-00-4D, 12-C33-00-4K, and 12-C33-29-2I contained 21-inch-diameter RCP located at depths between 7 feet and 10 feet bgs. The remaining TU319 trench segments contained 6-inch-diameter to 10-inch-diameter VCP located at depths ranging from 3 feet to 9 feet bgs.

An insufficient volume of sediment was available for sample collection and analysis in Manholes MH938, MH939, MH955, MH956, MH957, and MH958 and the six sections of pipe removed from TU319 during the Parcel C Phase II project area removal action. Consequently, there are no sediment sample analytical results associated with TU319.

Radiological survey activities were performed for the six manholes (MH938, MH939, MH955, MH956, MH957, and MH958), three sections of pipe removed from trench segment 12-C33-00-4K, and two sections of pipe removed from trench segment 12-C33-29-2I (Table 3-6). One section of steel pipe removed from trench segment 12-C33-00-3S was not surveyed, but was placed in LLRW bin GFLU002036T2 on February 6, 2013 for disposal by the DON radiological waste contractor since proper survey activities could not be performed due to metal oxidization. No elevated results were identified for the six manholes or five sections of TU319 pipe surveyed. Based on these results, the TU319 sections of pipe and the concrete and brick materials forming the six manholes were released and the debris transferred to the DON non-LLRW contractor for off-site disposal or recycling. Copies of the radiological survey reports are presented in Appendix J.

5.5.2 TU319 Piping Remaining in Place

No known storm drain or sanitary sewer systems piping associated with TU319 remained in place within Parcel C following completion of the Phase II time-critical removal action activities.

5.5.3 TU319 Final Status Survey Summary

A total of 18 systematic FSS soil samples were collected from the exposed sidewalls and bottom of TU319 and submitted to the laboratory for analysis on March 4, 2013 during the Parcel C Phase II project area removal action. No ROC concentrations above the release criteria specified in the AM (DON 2006) or the remediation goals established in the ROD (DON 2010) were identified in the TU319 FSS soil sample analytical results. The release criteria are identified in Tables 2-1 and 2-3, and the remediation goals are presented in Table 2-2. Figure 5-1 depicts the FSS soil sample collection locations in TU319. The range in the gamma scan survey and static survey count rates, and the FSS laboratory analytical reports were presented in Attachments 1 and 3, respectively, to the TU319 SUPR provided in Appendix D.

For the FSS, TU319 was defined as the sum of the trench unit and the backfill materials composed of both radiologically processed and released excavated soil survey units and a volume of imported fill. The average net residual ROC concentrations for materials used as backfill in TU319 were 0.020 pCi/g for Cs-137, 0.155 pCi/g for Sr-90, and -0.079 pCi/g for Ra-226. The trench unit average net residual ROC concentrations were 0.022 pCi/g for Cs-137, 0.155 pCi/g for Sr-90, and 0.015 pCi/g for Ra-226. The net Ra-226 concentration (with background Ra-226 subtracted) was used to calculate dose and risk. No background was subtracted from the Cs-137 or Sr-90 values since these radionuclides were not naturally occurring or expected due to nuclear weapons testing fallout at pipe depths.

RESRAD modeling using the larger of the MDL or net residual ROC and their decay product concentrations resulted in a dose of 0.5743 mrem/y with an increased cancer risk of 7.404×10^{-6} for the backfill material and 0.8115 mrem/y with an increased cancer risk of 1.126×10^{-5} for the trench unit (Yu et. al. 2001). These results were less than the NRC criterion of 25 mrem/y and the increased cancer risk falls within the EPA risk management range of 10^{-6} to 10^{-4} . The modeling parameters, values, and results were presented in Attachments 7 and 8 to the TU319 SUPR (Appendix D).

The results of the modeling efforts determined that the potential TU319 dose due to net residual ROC and their decay product concentrations greater than or equal to the MDL was 0.8115 mrem/y with an increased cancer risk of 1.126×10^{-5} , which supports radiological free release. Qualitative ALARA analyses resulted in: 1) no FSS gamma survey measurements above the investigation levels, 2) none of the FSS sample results identified net residual ROC concentrations above the release criteria, 3) no air monitoring results exceeded 10 percent of the derived air concentration for members of the public, and 4) no personnel dosimetry badges processed identified doses above background levels. No further radiological action was recommended in the TU319 SUPR (Appendix D). Table 3-1 summarizes the activities performed during the Parcel C Phase II project area removal action to support the recommended radiological free release of TU319.

5.5.4 TU319 Backfill Activities

Radiologically processed and released excavated soil survey units and a volume of imported fill were selected as the backfill materials for TU319. The excavated soil survey units selected as backfill material included:

- ES-774
- ES-787

Radiological information related to the processing of these excavated soil survey units is summarized in Table 3-4 and the associated laboratory analytical results are discussed in the TU319 SUPR (Appendix D). The radiological and chemical analytical reports for the imported fill are provided in Appendix K.

The ~~RASO~~ DON concurred with backfilling TU319 on April 24, 2013. At the direction of the DON, a small portion of TU319 was transferred to another HPNS remediation contractor to avoid impacting ongoing work activities in the area. Backfill operations for the remainder of TU319 commenced on July 15, 2013 and were completed on July 17, 2013. An estimated 1,709 cubic yards of soil was placed in TU319 to grade followed by the application of road base material over the backfilled trench. Backfill activities were performed in accordance with the HPNS Basewide Construction Specifications (TtEC 2012e). Parcel C Phase II project area restoration activities are described in Section 9.0.

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5.6 TRENCH SURVEY UNIT 320

Located in the southwest corner of Work Area 33 within Parcel C, TU320 is situated along C Street and west of non-radiologically impacted Buildings 72 and 203 (Figures 3-1 and 5-1). TU320 connects to TU319 on the north and TU321 on the south. A small portion of TU320 is located within IR Program Site IR-28. The chemicals of concern associated with IR-28 are listed in Table 3-9.

TU320 consists of three storm drain trench segments and five sanitary sewer trench segments. As identified on Figure 5-1 and Table 3-1, these trench segments include:

Storm Drain Trench Segments

- 12-C33-00-4O
- 12-C33-00-4P
- 12-C33-00-4Q

Sanitary Sewer Trench Segments

- 12-C33-00-4M
- 12-C33-00-4W
- 12-C33-00-8A
- 12-C33-00-8B
- 12-C33-28-3G

Sanitary sewer trench segment 12-C33-00-4M extends into TU319 on the north. With the exception of sanitary sewer trench segments 12-C33-00-8A and -8B, each of the trench segments associated with TU320 was identified in the Design Plan (TtEC 2012d). Trench segments 12-C33-00-8A and -8B were found during excavation of trench segment 12-C33-00-4M.

5.6.1 TU320 Removal Action Activities

Excavation activities for TU320 began on March 4, 2013 in trench segments 12-C33-00-4M and -4O. A total of 63 truckloads of soil (approximately 756 cubic yards) were excavated from TU320 during the Parcel C Phase II project area removal action (Table 3-3). Soil generated during excavation of TU320 was transferred to RSY4 for radiological processing (Table 3-4). Following completion of the excavation on March 12, 2013, TU320 had an exposed surface area of 708 m² and was 498 linear feet in length (Table 3-1). The maximum excavated TU320 depths ranged between 2 feet and 9 feet bgs (Table 3-2).

Manholes MH953 and MH954 and five sections of pipe were removed from TU320 during the Parcel C Phase II project area removal action and placed on plastic pending further activities (Figure 5-1). The majority of the TU320 piping crumbled during removal and the debris was transferred along with the surrounding excavated soil to RSY4 for radiological processing. As indicated in Table 3-2, sanitary sewer trench segment 12-C33-00-4M contained 10-inch-diameter VCP located at depths between 7 feet and 8 feet bgs. Sanitary sewer trench segments 12-C33-00-4W and 12-C33-28-3G contained 4-inch-diameter VCP located at depths ranging from 2 feet to 4 feet bgs. Trench segments 12-C33-00-8A and -8B contained 2-inch-diameter steel pipe located at depths ranging from 2 feet to 6 feet bgs. Storm drain trench segment 12-C33-00-4O contained 10-inch-diameter VCP located at an approximate depth of 8 feet bgs. The remaining trench segments associated with TU320 contained 6-inch-diameter VCP located at a depth of approximately 9 feet bgs.

An insufficient volume of sediment was available for sample collection and analysis in Manholes MH953 and MH954 and the five sections of pipe removed from TU320 during the Parcel C Phase II project area removal action. Consequently, there are no sediment sample analytical results associated with TU320.

Radiological survey activities were performed during the Parcel C Phase II project area time-critical removal action for Manholes MH953 and MH954 (Table 3-6). No elevated results were identified for the manholes surveyed (survey HPS-PCPIPE-031913-071). Based on these results, the brick and concrete materials forming Manholes MH953 and MH954 were released and the debris transferred to the DON non-LLRW contractor for off-site disposal or recycling. The five sections of 2-inch-diameter steel pipe removed from trench segments 12-C33-00-8A and -8B were not surveyed. These five sections of small diameter pipe were placed in LLRW bins GFLU002036T2 and GFLU001212T18 for off-site disposal by the DON radiological waste

contractor since proper surveys could not be performed. A copy of the radiological survey report is presented in Appendix J.

5.6.2 TU320 Piping Remaining in Place

No known storm drain or sanitary sewer systems piping associated with TU320 remained in place within Parcel C following completion of the Phase II time-critical removal action activities.

5.6.3 TU320 Final Status Survey Summary

Eighteen systematic FSS soil samples were collected from the exposed sidewalls and bottom of TU320 and submitted to the laboratory for analysis on April 9, 2013 during the Parcel C Phase II project area removal action. No ROC concentrations above the release criteria specified in the AM (DON 2006) or the remediation goals established in the ROD (DON 2010) were identified in the TU320 FSS soil sample analytical results. The release criteria are identified in Tables 2-1 and 2-3, and the remediation goals are presented in Table 2-2. Figure 5-1 depicts the FSS soil sample collection locations in TU320. The range in the gamma scan survey and static survey count rates, and the FSS laboratory analytical reports were presented in Attachments 1 and 3, respectively, to the TU320 SUPR provided in Appendix D.

TU320 was defined for the FSS as the sum of the trench unit and the backfill material composed of a volume of imported fill. The average net residual ROC concentrations for material used as backfill in TU320 were 0.020 pCi/g for Cs-137, 0.152 pCi/g for Sr-90 and -0.141 pCi/g for Ra-226. The trench unit average net residual ROC concentrations were 0.019 pCi/g for Cs-137, 0.185 pCi/g for Sr-90, and -0.173 pCi/g for Ra-226. The net Ra-226 concentration (with background Ra-226 subtracted) was used to calculate dose and risk. No background was subtracted from the Cs-137 or Sr-90 values since these radionuclides were not naturally occurring or expected due to nuclear weapons testing fallout at pipe depths.

RESRAD modeling using the larger of the MDL or reported net residual ROC concentrations resulted in a dose of 0.4748 mrem/y with an increased cancer risk of 6.144×10^{-6} for the backfill material and 0.5677 mrem/y with an increased cancer risk of 7.311×10^{-6} for the trench unit. These results were less than the NRC criterion of 25 mrem/y and the increased cancer risk falls within the EPA risk management range of 10^{-6} to 10^{-4} . The modeling parameters, values, and results were presented in Attachments 4 and 5 to the TU320 SUPR (Appendix D).

The results of the modeling efforts determined that the potential TU320 dose due to net residual ROC and their decay product concentrations greater than or equal to the MDL was 0.5677 mrem/y with an increased cancer risk of 7.311×10^{-6} , which supports radiological free release. Qualitative ALARA analyses resulted in: 1) no FSS gamma survey measurements above the investigation levels, 2) none of the FSS sample results identified net residual ROC concentrations above the release criteria, 3) no air monitoring results exceeded 10 percent of the derived air

concentration for members of the public, and 4) no personnel dosimetry badges processed identified doses above background levels. No further radiological action was recommended in the TU320 SUPR (Appendix D). Table 3-1 summarizes the activities performed during the Parcel C Phase II project area removal action to support the recommended radiological free release of TU320.

5.6.4 TU320 Backfill Activities

Imported fill was selected as the appropriate backfill material for TU320 because there were no suitable radiologically processed and released excavated soil survey units available. The radiological and chemical analytical reports for the imported fill are provided in Appendix K.

Concurrence with backfilling TU320 was obtained from the ~~RASO~~ ~~DON~~ on June 24, 2013. Backfill operations were initiated on July 3, 2013 and were completed on July 10, 2013. An estimated 708 cubic yards of soil was placed in TU320 to grade followed by the application of road base material over the backfilled trench. Backfill activities were performed in accordance with the HPNS Basewide Construction Specifications (TtEC 2012e). Parcel C Phase II project area restoration activities are described in Section 9.0

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5.7 TRENCH SURVEY UNIT 329

TU329 is located on the west side of Work Area 33 along Blandy Street and extends into the east side of Work Area 31 to the east of Drydock 4 within Parcel C (Figures 3-1 and 5-1). TU329 connects to TU328 on the north and TU330 on the south. On the east, TU329 terminates within the 10 foot buffer zone surrounding non-radiologically impacted Building 282. TU329 connects to TU209, which was excavated during the first phase of the Parcel C project area time-critical removal action. Small segments of TU329 are situated within IR Program Sites IR-29 and IR-57. The chemicals of concern associated with IR-29 and IR-57 are listed in Table 3-9.

TU329 is composed of seven storm drain trench segments and four sanitary sewer trench segments. As identified on Figure 5-1 and Table 3-1, these trench segments include:

Storm Drain Trench Segments

- 12-C31-57-2C
- 12-C33-00-2X
- 12-C33-00-2Z
- 12-C33-00-3A
- 12-C33-00-3C
- 12-C33-00-3F

Sanitary Sewer Trench Segments

- 12-C33-00-1G
- 12-C33-00-3D
- 12-C33-00-3E
- 12-C33-29-2B

- 12-C33-00-3G

Trench segments 12-C33-00-1G and -2Z continued into TU328 on the north. Trench segments 12-C33-00-3E and -3G transitioned into TU330 on the south. Each of the trench segments associated with TU329 was identified in the Design Plan (TtEC 2012d).

5.7.1 TU329 Removal Action Activities

Excavation activities for TU329 were initiated on May 14, 2013 in sanitary sewer trench segment 12-C33-00-3E. A total of 103 truckloads of soil (approximately 1,236 cubic yards) were excavated from TU329 during the Parcel C Phase II project area removal action (Table 3-3). Soil generated during excavation of TU329 was transferred to RSY4 for radiological processing (Table 3-4). Following completion of the excavation on May 22, 2013, TU329 exhibited an exposed surface area of 956 m² and was 514 linear feet in length (Table 3-1). The maximum excavated TU329 depths ranged between 5 feet and 11 feet bgs (Table 3-2).

Manholes MH930 and MH931 and 38 sections of pipe were removed from TU329 during the Parcel C Phase II project area removal action and placed on plastic pending further activities (Figure 5-1). The majority of the TU329 piping disintegrated during removal and the debris was transferred along with the surrounding excavated soil to RSY4 for radiological processing. As indicated in Table 3-2, storm drain trench segments 12-C31-57-2C and 12-C33-00-3F contained 10-inch-diameter VCP located at depths ranging from 8 feet to 10 feet bgs. Sanitary sewer trench segments 12-C33-00-1G and -3E contained 21-inch-diameter RCP located at depths between 8 feet and 9 feet bgs. Trench segment 12-C33-00-2X contained 6-inch-diameter CIP and trench segments 12-C33-00-3D and 12-C33-29-2B contained 4-inch-diameter CIP. The pipe sections in these three trench segments were located at depths between 5 feet and 10 feet bgs. The remaining trench segments contained 27-inch-diameter VCP located at depths ranging from 8 feet to 9 feet bgs.

An insufficient volume of sediment was available for sample collection and analysis in Manholes MH930 and MH931 and the 38 sections of pipe removed from TU329 during the Parcel C Phase II project area removal action. Consequently, there are no sediment sample analytical results associated with TU329.

As identified in Table 3-6, radiological survey activities were performed for Manholes MH930 and MH931 (survey HPS-PCPIPE-100713-094); 1 section of pipe removed from trench segment 12-C33-00-1G (survey HPS-PCPIPE-100813-095); 6 sections of pipe removed from trench segment 12-C33-00-2Z (survey HPS-PCPIPE-072513-085); 3 sections of pipe removed from trench segment 12-C33-00-3A (survey HPS-PCPIPE-072313-083); 16 sections of pipe removed from trench segment 12-C33-00-3C (survey HPS-PCPIPE-073013-092); 1 section of pipe removed from trench segment 12-C33-00-3E (survey HPS-PCPIPE-100813-095); and, 11 sections

of pipe removed from trench segment 12-C33-00-3G (survey HPS-PCPIPE-072613-089). No elevated results were identified for the two manholes or 38 sections of pipe surveyed. Based on these results, the brick and concrete materials forming Manholes MH930 and MH931 and the 38 sections of pipe were released and the debris transferred to the DON non-LLRW contractor for off-site disposal or recycling. Copies of the radiological survey reports are presented in Appendix J.

5.7.2 TU329 Piping Remaining in Place

A total of 13 linear feet of storm drain trench segment 12-C33-00-2X 6-inch-diameter CIP was excavated prior to being terminated near non-radiologically impacted Building 215 occupied by the Federal Police during the Parcel C Phase II project area removal action activities. Based on historical drawings, and estimated 34 linear feet of trench segment 12-C33-00-2X pipe was left in place to protect access and service to Building 215 (Table 3-7). To ensure that no residual radioactivity above the release criteria was associated with the 34 linear feet of pipe remaining in place, radiological survey activities were performed on August 13, 2013 (HPS-PCPIPE-072413-086). No elevated results were identified for the pipe remaining in place. Based on these results, the DON concluded that the 34 linear feet of pipe remaining in place was unlikely to be contaminated. A copy of the survey report is provided in Appendix J.

5.7.3 TU329 Final Status Survey Summary

A total of 18 systematic FSS soil samples were collected from the exposed sidewalls and bottom of TU329 and submitted to the laboratory for analysis on June 27, 2013 during the Parcel C Phase II project area removal action. No ROC concentrations above the release criteria specified in the AM (DON 2006) or the remediation goals established in the ROD (DON 2010) were identified in the TU329 FSS soil sample analytical results. The release criteria are identified in Tables 2-1 and 2-3, and the remediation goals are presented in Table 2-2. Figure 5-1 depicts the FSS soil sample collection locations in TU329. The range in the gamma scan survey and static survey count rates, and the FSS laboratory analytical reports were presented in Attachments 1 and 3, respectively, to the TU329 SUPR provided in Appendix D.

For the FSS, TU329 was defined as the sum of the trench unit and the backfill materials composed of both radiologically processed and released excavated soil survey units and a volume of imported fill. The average net residual ROC concentrations for materials used as backfill in TU329 were 0.021 pCi/g for Cs-137, 0.197 pCi/g for Sr-90, and 0.061 pCi/g for Ra-226. The trench unit average net residual ROC concentrations were 0.020 pCi/g for Cs-137, 0.188 pCi/g for Sr-90, and -0.028 pCi/g for Ra-226. The net Ra-226 concentration (with background Ra-226 subtracted) was used to calculate dose and risk. No background was subtracted from the Cs-137 or Sr-90 values since these radionuclides were not naturally occurring or expected due to nuclear weapons testing fallout at pipe depths.

RESRAD modeling using the larger of the MDL or reported net ROC concentrations resulted in a dose of 1.826 mrem/y with an increased cancer risk of 2.667×10^{-5} for the backfill material and 0.7677 mrem/y with an increased cancer risk of 9.850×10^{-6} for the trench unit (Yu et. al. 2001). These results were less than the NRC criterion of 25 mrem/y and the increased cancer risk falls within the EPA risk management range of 10^{-6} to 10^{-4} . The modeling parameters, values, and results were presented in Attachments 7 and 8 to the TU329 SUPR (Appendix D).

The results of the modeling efforts determined that the potential TU329 dose due to net residual ROC and their decay product concentrations greater than or equal to the MDL was 1.826 mrem/y with an increased cancer risk of 2.667×10^{-5} , which supports radiological free release. Qualitative ALARA analyses resulted in: 1) no FSS gamma survey measurements above the investigation levels, 2) none of the FSS sample results identified net residual ROC concentrations above the release criteria, 3) no air monitoring results exceeded 10 percent of the derived air concentration for members of the public, and 4) no personnel dosimetry badges processed identified doses above background levels. No further radiological action was recommended in the TU329 SUPR (Appendix D). Table 3-1 summarizes the activities performed during the Parcel C Phase II project area removal action to support the recommended radiological free release of TU329.

5.7.4 TU329 Backfill Activities

Radiologically processed and released excavated soil survey units and a volume of imported fill were selected as the backfill materials for TU329. The excavated soil survey units selected as backfill material included:

- ES-804
- ES-822
- ES-825
- ES-826

Radiological information related to the processing of these excavated soil survey units is summarized in Table 3-4 and the associated laboratory analytical results are discussed in the TU329 SUPR (Appendix D). The radiological and chemical analytical reports for the imported fill are provided in Appendix K.

At the direction of the DON, backfill activities for TU329 were initiated on October 10, 2013 and completed on October 14, 2013. Although the draft TU329 SUPR and request for backfill was submitted to the ~~RASO~~ DON on September 4, 2013, concurrence with backfilling TU329 was not obtained until November 8, 2013 (Table 3-1). An estimated 1,177 cubic yards of soil was placed in TU329 to grade followed by the application of road base material over the backfilled trench. In addition, a stormwater swale was constructed over a portion of the backfilled trench. Backfill

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Draft Radiological Construction Summary Report

Parcel C Phase II
Hunters Point Naval Shipyard
DCN: RMAC-0809-0012-0049
CTO No. 0012

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activities were performed in accordance with the HPNS Basewide Construction Specifications (TtEC 2012e). Parcel C Phase II project area restoration activities are described in Section 9.0.

5.8 TRENCH SURVEY UNIT 330

TU330 is located on the west side of Work Area 33 along Blandy Street in Parcel C and extends toward the southwest into Work Area 31 and toward Drydock 4 (Figures 3-1 and 5-1). TU330 connects to TU329 on the north, TU319 on the east, and TU331 on the south. On the west, TU330 connects to TU209, which was excavated during the first phase of the Parcel C project area time-critical removal action.

TU330 consists of nine storm drain trench segments and three sanitary sewer trench segments. As identified on Figure 5-1 and Table 3-1, these trench segments include:

<u>Storm Drain Trench Segments</u>	<u>Sanitary Sewer Trench Segments</u>
• 12-C31-57-2G	• 12-C33-00-3E
• 12-C31-57-8A	• 12-C33-29-2C
• 12-C33-00-3G	• 12-C33-29-2J
• 12-C33-00-3U	
• 12-C33-00-8C	
• 12-C33-29-2G	
• 12-C33-29-2H	
• 12-C33-29-2L	
• 12-C33-29-8A	

Trench segments 12-C33-00-3E and -3G extended into TU329 on the north and trench segment 12-C33-29-2H continued into TU319 on the east. Trench segment 12-C33-29-2L transitioned into TU331 on the south. With the exception of storm drain trench segments 12-31-57-8A, 12-C33-00-8C, and 12-C33-29-8A, each of the trench segments associated with TU330 was identified in the Design Plan (TtEC 2012d). Although identified in the Design Plan, pipe in trench segment 12-C33-29-2K could not be found after several excavation attempts.

5.8.1 TU330 Removal Action Activities

Excavation activities for TU330 began on January 10, 2013 in sanitary sewer trench segment 12-C33-29-2J. A total of 121 truckloads of soil (approximately 1,452 cubic yards) were excavated from TU330 during the Parcel C Phase II project area removal action (Table 3-3). Soil generated during excavation of TU330 was transferred to RSY4 for radiological processing (Table 3-4). Following completion of the excavation on May 28, 2013, TU330 had an exposed surface area of

851 m² and was 331 linear feet in length (Table 3-1). The maximum excavated TU330 depths ranged between 7 feet and 11 feet bgs (Table 3-2).

Manhole MH937 and 43 sections of pipe were removed from TU330 during the Parcel C Phase II project area removal action and placed on plastic pending further activities (Figure 5-1). The majority of the TU330 piping crumbled during removal and the debris was transferred along with the surrounding excavated soil to RSY4 for radiological processing. As indicated in Table 3-2, storm drain trench segments 12-C31-57-2G and 12-C33-00-3U contained 10-inch-diameter VCP located at depths between 6 feet and 9 feet bgs. Sanitary sewer trench segments 12-C33-00-3E and 12-C33-29-2C contained 21-inch-diameter RCP located at depths ranging from 8 feet to 9 feet bgs. Sanitary sewer trench segment 12-C33-29-2J contained 18-inch-diameter RCP located at a depth of about 9 feet bgs. Storm drain trench segment 12-C33-29-2H contained 15-inch-diameter VCP located at an estimated depth of 9 feet bgs. The remaining trench segments contained either 12-inch-diameter or 27-inch-diameter VCP located at depths ranging from 6 feet to 9 feet bgs.

A sufficient volume of sediment was available for sample collection and analysis in one pipe section removed from trench segment 12-C33-29-2C (sample 12-PCPI-0012-01) and one pipe section removed from trench segment 12-C33-29-2J (sample 12-PCPI-0007-01) during the Parcel C Phase II project area removal action (Table 3-5). The sediment sample collected from the section of pipe removed from trench segment 12-C33-29-2C also was submitted to the laboratory for total strontium analysis. The laboratory analytical results did not identify the presence of contamination above the release criteria in the sediment sample collected from trench segment 12-C3-29-2C. However, the laboratory analytical results identified the presence of Cs-137 above the release limit at 0.1959 pCi/g in the sediment sample collected from the pipe section removed from trench segment 12-C33-29-2J. Based on this result, two contiguous sections of trench segment 12-C33-29-2J RCP were placed in LLRW bins GFLU002055T1 and GFLU0011168T2 pending transfer to the DON radiological waste contractor for off-site disposal. The analytical results for the sediment samples collected from the TU330 pipe sections are provided in Appendix I.

As indicated in Table 3-6, radiological survey activities were performed for Manhole MH937 (survey HPS-PCPIPE-100813-096); 20 sections of VCP removed from trench segment 12-C33-00-3G (survey HPS-PCPIPE-072613-089); 2 sections of RCP removed from trench segment 12-C33-29-2C (survey HPS-PCPIPE-100813-095); 6 sections of VCP removed from trench segment 12-C33-29-2G (survey HPS-PCPIPE-072313-082); and, 12 sections of VCP removed from trench segment 12-C33-29-2L (survey HPS-PCPIPE-072313-082). Although one section of trench segment 12-C33-29-2C RCP was removed and placed on plastic during the Parcel C Phase II project area removal action activities, this 16 foot section of 21-inch-diameter pipe was not surveyed and was placed in LLRW bin GFLU002055T1 on February 13, 2014 to expedite field activities. No elevated results were identified for the 40 sections of TU330 pipe surveyed. Based on these results, the 40 sections of pipe were released and the debris transferred to the DON non-

LLRW contractor for off-site disposal or recycling. Copies of the radiological survey reports are presented in Appendix J.

Initially, a total of three investigative soil samples were collected from the exposed bottom of TU330 on July 8, 2013 and submitted to the laboratory for analysis due to the presence of Cs-137 contamination in the trench segment 12-C33-29-2J sediment sample analytical results (Tables 3-1 and 3-5). No ROC concentrations exceeding the release criteria were identified in the investigative soil sample analytical results. The laboratory analytical results were provided in Attachment 2 to the TU330 SUPR provided in Appendix D.

5.8.2 TU330 Piping Remaining in Place

No known storm drain or sanitary sewer systems piping associated with TU330 remained in place within Parcel C following completion of the Phase II time-critical removal action activities.

5.8.3 TU330 Final Status Survey Summary

Eighteen systematic FSS soil samples were collected from the exposed sidewalls and bottom of TU330 and submitted to the laboratory for analysis on July 16, 2013 during the Parcel C Phase II project area removal action. No ROC concentrations above the release criteria specified in the AM (DON 2006) or the remediation goals established in the ROD (DON 2010) were identified in the TU330 FSS soil sample analytical results. The release criteria are identified in Tables 2-1 and 2-3, and the remediation goals are presented in Table 2-2. Figure 5-1 depicts the FSS soil sample collection locations in TU330. The range in the gamma scan survey static survey count rates, and the FSS laboratory analytical reports were presented in Attachments 1 and 3, respectively, to the TU330 SUPR provided in Appendix D.

TU330 was defined for the FSS as the sum of the trench unit and the backfill materials composed of both radiologically processed and released excavated soil survey units and a volume of imported fill. The average net residual ROC concentrations for materials used as backfill in TU330 were 0.019 pCi/g for Cs-137, 0.164 pCi/g for Sr-90, and -0.110 pCi/g for Ra-226. The trench unit average net residual ROC concentrations were 0.019 pCi/g for Cs-137, 0.160 pCi/g for Sr-90, and -0.152 pCi/g for Ra-226. The net Ra-226 concentration (with background Ra-226 subtracted) was used to calculate dose and risk. No background was subtracted from the Cs-137 or Sr-90 values since these radionuclides were not naturally occurring or expected due to nuclear weapons testing fallout at pipe depths.

RESRAD modeling using the larger of the MDL or reported net residual ROC and their decay product concentrations resulted in a dose of 0.6028 mrem/y with an increased cancer risk of 7.756×10^{-6} for the backfill material and 0.589 mrem/y with an increased cancer risk of 7.582×10^{-6} for the trench unit (Yu et. al. 2001). These results were less than the NRC criterion of 25 mrem/y and the increased cancer risk falls within the EPA risk management range of 10^{-6} to 10^{-4} . The modeling

parameters, values, and results were presented in Attachments 7 and 8 to the TU330 SUPR (Appendix D).

The results of the modeling efforts determined that the potential TU330 dose due to net residual ROC and their decay product concentrations greater than or equal to the MDL was 0.6028 mrem/y with an increased cancer risk of 7.756×10^{-6} , which supports radiological free release. Qualitative ALARA analyses resulted in: 1) no FSS gamma survey measurements above the investigation levels, 2) none of the FSS sample results identified net residual ROC concentrations above the release criteria, 3) no air monitoring results exceeded 10 percent of the derived air concentration for members of the public, and 4) no personnel dosimetry badges processed identified doses above background levels. No further radiological action was recommended in the TU330 SUPR (Appendix D). Table 3-1 summarizes the activities performed during the Parcel C Phase II project area removal action to support the recommended radiological free release of TU330.

5.8.4 TU330 Backfill Activities

Radiologically processed and released excavated soil survey units and a volume of imported fill were selected as the backfill materials for TU330. The excavated soil survey units selected as backfill materials included:

- ES-803
- ES-807
- ES-827

Radiological information related to the processing of these excavated soil survey units is summarized in Table 3-4 and the associated laboratory analytical results are discussed in the TU330 SUPR (Appendix D). The radiological and chemical analytical reports for the imported fill are provided in Appendix K.

At the direction of the DON, backfill activities for TU330 began on October 14, 2013 and completed on October 16, 2013. Although the draft TU330 SUPR and request for backfill was submitted to the **RASO/DON** on September 6, 2013, concurrence with backfilling TU330 was not obtained until November 8, 2013 (Table 3-1). An estimated 1,263 cubic yards of soil was placed in TU330 to grade followed by the application of road base material over the backfill trench. In addition, a stormwater swale was constructed over a portion of the backfilled trench. Backfill activities were performed in accordance with the HPNS Basewide Construction Specifications (TtEC 2012e). Parcel C Phase II project area restoration activities are described in Section 9.0.

Commented [MPL31]: Navy

5.9 TRENCH SURVEY UNIT 331

TU331 is located in the southwest corner of Work Area 33 along Blandy Street in Parcel C and extends toward the southwest into Work Area 31 and toward Drydock 4 (Figures 3-1 and 5-1). TU331 connects to TU330 on the north and TU332 on the south. On the west, TU331 connects to TU209, which was excavated during the first phase of the Parcel C project area time-critical removal action. Portions of TU331 are situated within IR Program Sites IR-29 and IR-57. The chemicals of concern associated with IR-29 and IR-57 are listed in Table 3-9.

TU331 is composed of nine storm drain trench segments and no sanitary sewer trench segments. As identified on Figure 5-1 and Table 3-1, these trench segments include:

- 12-C31-57-2H
- 12-C31-57-2I
- 12-C33-00-3V
- 12-C33-00-3W
- 12-C33-00-3X
- 12-C33-00-3Y
- 12-C33-00-3Z
- 12-C33-00-4N
- 12-C33-29-2L

Trench segment 12-C33-00-3Z continued toward the south into TU332 and trench segment 12-C33-29-2L extended toward the north into TU330. Each of the trench segments associated with TU331 was identified in the Design Plan (TtEC 2012d). Although identified in the Design Plan, pipe in trench segments 12-C33-29-2K and -2M could not be found after several excavation attempts. In addition, a utility vault previously identified as Manhole MH1139 in the Design Plan was not removed.

5.9.1 TU331 Removal Action Activities

Excavation activities for TU331 were initiated on May 28, 2013 in storm drain trench segments 12-C31-57-2H and 12-C33-29-2L. A total of 50 truckloads of soil (approximately 600 cubic yards) were excavated from TU331 during the Parcel C Phase II project area removal action (Table 3-3). Soil generated during excavation of TU331 was transferred to both RSY3 and RSY4 for radiological processing (Table 3-4). Following completion of the excavation on June 5, 2013, TU331 exhibited an exposed surface area of 602 m² and was 303 linear feet in length (Table 3-1). The maximum excavated TU331 depths ranged between 5 feet and 8 feet bgs (Table 3-2).

Manhole MH941 and 31 sections of pipe were removed from TU331 during the Parcel C Phase II project area removal action and placed on plastic pending further activities (Figure 5-1). The majority of the TU331 piping disintegrated during removal and the debris was transferred along with the surrounding excavated soil to RSY3 and RSY4 for radiological processing. As indicated in Table 3-2, storm drain trench segments 12-C31-57-2H and 12-C33-00-3V contained 10-inch-diameter RCP located at a depth of approximately 5 feet bgs. Trench segments 12-C31-57-2I and

12-C33-00-3W contained 10-inch-diameter VCP located at a depth of about 5 feet bgs. Trench segments 12-C33-00-3X and -3Z contained 30-inch-diameter VCP located at a depth of approximately 6 feet bgs. Trench segment 12-C33-00-3Y contained 4-inch-diameter steel pipe located at a depth of about 5 feet bgs. Trench segments 12-C33-00-4N and 12-C33-29-2L contained 27-inch-diameter VCP located at a depth of approximately 6 feet bgs.

An insufficient volume of sediment was available for sample collection and analysis in Manhole MH941 or the 31 sections of pipe removed from TU331 during the Parcel C Phase II project area removal action. Consequently, there are no sediment sample analytical results associated with TU331.

As indicated in Table 3-6, radiological survey activities were performed for Manhole MH941 (survey HPS-PCPIPE-071513-078); 3 sections of pipe removed from trench segment 12-C31-57-2H (survey HPS-PCPIPE-071513-079); 5 sections of pipe removed from trench segment 12-C33-00-3V (HPS-PCPIPE-071513-079); 13 sections of pipe removed from trench segment 12-C33-00-3X (survey HPS-PCPIPE-073013-093); 7 sections of pipe removed from trench segment 12-C33-00-3Z (HPS-PCPIPE-072513-085); and, 2 sections of pipe removed from trench segment 12-C33-00-4N (survey HPS-PCPIPE-072313-083). Although one section of trench segment 12-C33-00-3Y 4-inch-diameter steel pipe was removed and placed on plastic during the Parcel C Phase II project area removal action activities, this 15 foot section was placed in LLRW bin GFLU001190T13 on July 22, 2013 for off-site disposal by the DON radiological waste contractor since it was too narrow in diameter to properly survey.

No elevated results were identified for the 30 sections of TU331 pipe surveyed. Based on these results, the 30 sections of pipe were released and the debris transferred to the DON non-LLRW contractor for off-site disposal or recycling. The survey results for Manhole MH941 identified one net beta/gamma static measurement value above the release limit at 1,083 dpm/100 cm². Based on this result, the brick materials forming Manhole MH941 were placed in LLRW bin GFLU002035T3 on July 22, 2013 pending off-site disposal by the DON radiological waste contractor. Copies of the radiological survey reports are presented in Appendix J.

5.9.2 TU331 Piping Remaining in Place

No known storm drain or sanitary sewer systems piping associated with TU331 remained in place within Parcel C following completion of the Phase II time-critical removal action activities.

5.9.3 TU331 Final Status Survey Summary

A total of 18 systematic FSS soil samples were collected from the exposed sidewalls and bottom of TU331 and submitted to the laboratory for analysis on July 10, 2013 during the Parcel C Phase II project area removal action. No ROC concentrations above the release criteria specified in the AM (DON 2006) or the remediation goals established in the ROD (DON 2010) were identified in

the TU331 FSS soil sample analytical results. The release criteria are identified in Tables 2-1 and 2-3, and the remediation goals are presented in Table 2-2. Figure 5-1 depicts the FSS soil sample collection locations in TU331. The range in the gamma scan survey and static survey count rates, and the FSS laboratory analytical reports were presented in Attachments 1 and 3, respectively, to the TU331 SUPR provided in Appendix D.

For the FSS, TU331 was defined as the sum of the trench unit and the backfill materials composed of both radiologically processed and released excavated soil survey units and a volume of imported fill. The average net residual ROC concentrations for materials used as backfill in TU331 were 0.020 pCi/g for Cs-137, 0.166 pCi/g for Sr-90, and -0.102 pCi/g for Ra-226. The trench unit average net residual ROC concentrations were 0.020 pCi/g for Cs-137, 0.161 pCi/g for Sr-90, and -0.103 pCi/g for Ra-226. The net Ra-226 concentration (with background Ra-226 subtracted) was used to calculate dose and risk. No background was subtracted from the Cs-137 or Sr-90 values since these radionuclides were not naturally occurring or expected due to nuclear weapons testing fallout at pipe depths.

RESRAD modeling using the larger of the MDL or net residual ROC and their decay product concentrations resulted in a dose of 0.4434 mrem/y with an increased cancer risk of 5.746×10^{-6} for the backfill material and 0.4312 mrem/y with an increased cancer risk of 5.592×10^{-6} for the trench unit (Yu et. al. 2001). These results were less than the NRC criterion of 25 mrem/y and the increased cancer risk falls within the EPA risk management range of 10^{-6} to 10^{-4} . The modeling parameters, values, and results were presented in Attachments 7 and 8 to the TU331 SUPR (Appendix D).

The results of the modeling efforts determined that the potential TU331 dose due to net residual ROC and their decay product concentrations greater than or equal to the MDL was 0.4434 mrem/y with an increased cancer risk of 5.746×10^{-6} , which supports radiological free release. Qualitative ALARA analyses resulted in: 1) no FSS gamma survey measurements above the investigation levels, 2) none of the FSS sample results identified residual ROC concentrations above the release criteria, 3) no air monitoring results exceeded 10 percent of the derived air concentration for members of the public, and 4) no personnel dosimetry badges processed identified doses above background levels. No further radiological action was recommended in the TU331 SUPR (Appendix D). Table 3-1 summarizes the activities performed during the Parcel C Phase II project area removal action to support the recommended radiological free release of TU331.

5.9.4 TU331 Backfill Activities

Radiologically processed and released excavated soil survey units and a volume of imported fill were selected as the backfill materials for TU331. The excavated soil survey units selected as backfill material included:

- ES-828
- ES-830

Radiological information related to the processing of these excavated soil survey units is summarized in Table 3-4 and the associated laboratory analytical results are discussed in the TU331 SUPR (Appendix D). The radiological and chemical analytical reports for the imported fill are provided in Appendix K.

At the direction of the DON, backfill activities for TU331 were initiated on October 17, 2013 and completed on October 18, 2013. Although the draft TU331 SUPR and request for backfill was submitted to the ~~RASO~~ DON on September 27, 2013, concurrence with backfilling TU331 was not obtained until November 8, 2013 (Table 3-1). An estimated 846 cubic yards of soil was placed in TU331 to grade followed by the application of road base material over the backfilled trench. In addition, a stormwater swale was constructed over a portion of the backfilled trench. Backfill activities were performed in accordance with the HPNS Basewide Construction Specifications (TtEC 2012e). Parcel C Phase II project area restoration activities are described in Section 9.0.

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5.10 TRENCH SURVEY UNIT 338

Extending into Work Area 31 on the south and Work area 34 on the east, TU338 is located at the southeast corner of Work Area 33 to the east of Building 226 and southeast of Building 228 (Figures 3-1 and 5-1). The northern portion of TU338 is situated with IR Program Site IR-28. The chemicals of concern associated with IR-28 are listed in Table 3-9.

TU338 is composed of nine storm drain trench segments and five sanitary sewer trench segments. As identified on Figure 5-1 and Table 3-1, these trench segments include:

Storm Drain Trench Segments

- 12-C31-00-2H
- 12-C31-00-2I
- 12-C31-00-2K
- 12-C31-00-8D
- 12-C33-28-3O
- 12-C34-00-8E
- 12-C34-28-3N
- 12-C34-28-3Q
- 12-C34-28-3Z

Sanitary Sewer Trench Segments

- 12-C33-28-3L
- 12-C33-28-3V
- 12-C34-00-1H
- 12-C34-28-5M
- 12-C34-28-5P

Sanitary sewer trench segment 12-C33-28-3L and storm drain trench segment 12-C33-28-3L transition into TU315 on the west. Sanitary sewer trench segments 12-C34-00-1H and 12-C34-28-5P extend into TU323 on the east. Storm drain trench segment 12-C34-28-3Q and sanitary sewer trench segment 12-C34-28-5M continue into TU337 on the north. On the south, TU338 was terminated approximately 30 feet from the San Francisco Bay outfall to facilitate future stormwater system installation activities. With the exception of trench segments 12-C31-00-8D and 12-C34-00-8E, each of the trench segments associated with TU338 was identified in the Design Plan (TtEC 2012d). Storm drain trench segments 12-C31-00-8D and 12-C34-00-8E were found during excavation of manhole MH967 and trench segment 12-C34-00-1H.

5.10.1 TU338 Removal Action Activities

Excavation activities for TU338 began on February 26, 2013 in trench segment 12-C34-28-5P. A total of 145 truckloads of soil (approximately 1,740 cubic yards) were excavated from TU338 during the Parcel C Phase II project area removal action (Table 3-3). Soil generated during excavation of TU338 was transferred to RSY4 for radiological processing (Table 3-4). Following completion of the excavation on October 4, 2013, TU338 exhibited an exposed surface area of 966 m² and was 436 linear feet in length (Table 3-1). The maximum excavated TU338 depths ranged between 5 feet and 9 feet bgs (Table 3-2).

Manholes MH966, MH967, and MH971, and 30 sections of pipe were removed from TU338 during the Parcel C Phase II project area removal action and placed on plastic pending further activities (Figure 5-1). The majority of the TU338 piping disintegrated upon removal and the debris was transferred along with the surrounding excavated soil to RSY4 for radiological processing. As indicated in Table 3-2, storm drain trench segments 12-C31-00-2I, -2K, and 12-C34-28-3Z contained 30-inch-diameter VCP located at depths between 5 feet and 7 feet bgs. Storm drain trench segments 12-C31-00-8D and 12-C34-00-8E contained 6-inch-diameter VCP located at a depth of approximately 5 feet bgs. Sanitary sewer trench segments 12-C33-28-3L and 12-C34-28-5P contained 18-inch-diameter and 12-inch-diameter, respectively, RCP located at a depth of approximately 6 feet bgs. The remainder of the trench segments contained 6-inch-diameter to 27-inch-diameter VCP located at depths between 5 feet and 6 feet bgs (Table 3-2).

A sufficient volume of sediment was available for sample collection and analysis in one section of pipe removed from trench segment 12-C34-28-5P (sample 12-PCPI-0016-01) during the Parcel C Phase II removal action (Table 3-5). No ROC concentrations above the release criteria were identified by the laboratory analytical results for this sediment sample. The sediment sample laboratory analytical reports are provided in Appendix I.

Radiological survey activities were performed for manholes MH966 (survey HPS-PCPIPE-101713-107), MH967 (survey HPS-PCPIPE-101513-102), and MH971 (survey HPS-PCPIPE-101513-102), 2 sections of pipe removed from trench segment 12-C31-00-2I (survey HPS-

PCPIPE-101613-105), 28 sections of pipe removed from trench segment 12-C31-00-2K (survey HPS-PCPIPE-101413-101), 7 sections of pipe removed from trench segment 12-C33-28-3L (survey HPS-PCPIPE-101613-106), and 3 sections of pipe removed from trench segment 12-C34-28-5P (survey HPS-PCPIPE-101613-106) during the Parcel C Phase II removal action activities (Table 3-6). None of the survey results identified the presence of elevated measurements. Based on these results, the brick and concrete materials forming the manholes and the 30 sections of pipe were released and the debris transferred to the DON non-LLRW contractor for off-site disposal or recycling. Copies of the radiological survey reports are presented in Appendix J.

Initially, 18 systematic soil samples were collected from the exposed sidewalls and bottom of TU338 on October 17, 2013 and submitted to the laboratory for screening analysis. The analytical results identified the presence of Ra-226 activity in one soil sample at 1.490 pCi/g, which is greater than the SUPR Abstract release criterion, but below the NORM Abstract (Appendix A) release criterion (Table 2-4). The DON concluded that the relatively elevated Ra-226 activity was likely due to the presence of NORM fill materials as described in Section 2.5.8. For consistency, a replacement systematic soil sample was collected and analyzed. The analytical results were less than the NORM Abstract release criterion for Ra-226 (Appendix A). Figure 5-2 depicts the location of the Ra-226 soil sample associated with the NORM fill material.

5.10.2 TU338 Piping Remaining in Place

A total of 60 linear feet of storm drain trench segment 12-C31-00-2K was excavated prior to being terminated near the San Francisco Bay outfall during the Parcel C Phase II project area removal action activities. Based on historical drawings, approximately 30 linear feet of trench segment 12-C31-00-2K remained in place to facilitate the installation of future stormwater controls (Table 3-7). To ensure that no residual radioactivity above the release criteria was associated with the 30 linear feet of pipe remaining in place, radiological survey activities were performed on March 20, 2014 at the north end of the pipe remaining in place (survey HPS-PCPIPE-032014-117). No elevated survey results were identified for the trench segment 12-C31-00-2K piping. Based on these results, the DON concluded that the 30 linear feet of pipe remaining in place was unlikely to be contaminated. A copy of the survey report is provided in Appendix J.

5.10.3 TU338 Final Status Survey Summary

Eighteen systematic soil samples were collected from the exposed sidewalls and bottom of TU338 and submitted to the laboratory for definitive analysis during the Parcel C Phase II project area removal action. No ROC concentrations above the release criteria specified in the NORM Abstract (Appendix A) were identified in the TU338 FSS soil sample analytical results for the . The NORM Abstract release criteria are specified in Table 2-4. Figure 5-1 depicts the FSS soil sample collection locations in TU338. The range in the gamma scan surveys and static survey count rates were presented in Attachment 1 to the TU338 SUPR provided in Appendix D. The definitive

laboratory analytical reports for the FSS soil samples were included in Attachment 3 to the TU338 SUPR (Appendix D).

For the FSS, TU338 was defined as the sum of the trench unit and the backfill materials composed of both radiologically processed and released excavated soil survey units and a volume of imported fill. The average net residual ROC concentrations for materials used as backfill were 0.020 pCi/g for Cs-137, 0.152 pCi/g for Sr-90, and -0.054 pCi/g for Ra-226. The trench unit average net residual ROC concentrations were 0.021 pCi/g for Cs-137, 0.160 pCi/g for Sr-90, and -0.504 pCi/g for Ra-226. The net Ra-226 concentration (with background Ra-226 subtracted) was used to calculate dose and risk. No background was subtracted from the Cs-137 or Sr-90 values since these radionuclides were not naturally occurring or expected due to nuclear weapons testing fallout at pipe depths.

RESRAD modeling using the larger of the MDL or reported net residual ROC and their decay product concentrations resulted in a dose of 0.4692 mrem/y with an increased cancer risk of 6.074×10^{-6} for the backfill material and 0.4938 mrem/y with an increased cancer risk of 6.392×10^{-6} for the trench unit (Yu et. al. 2001). These results were less than the NRC criterion of 25 mrem/y and the increased cancer risk falls within the EPA risk management range of 10^{-6} to 10^{-4} . The modeling parameters, values, and results were presented in Attachments 7 and 8 to the TU338 SUPR (Appendix D).

The results of the modeling efforts determined that the potential TU338 dose due to the net residual ROC and their decay product concentrations greater than or equal to the MDL was 0.4938 mrem/y with an increased cancer risk of 6.392×10^{-6} , which supports radiological free release. Qualitative ALARA analyses resulted in: 1) no FSS gamma survey measurements above the investigation levels, 2) none of the FSS sample results identified residual ROC concentrations above the release criteria specified in Table 2-4, 3) no air monitoring results exceeded 10 percent of the derived air concentration for members of the public, and 4) no personnel dosimetry badges processed identified doses above background levels. No further radiological action was recommended in the TU338 SUPR (Appendix D). Table 3-1 summarizes the activities performed during the Parcel C Phase II project area removal action to support the recommended radiological free release of TU338.

5.10.4 TU338 Backfill Activities

Radiologically processed and released excavated soil survey units and a volume of imported fill were selected as the backfill materials for TU338. The excavated soil survey units selected as backfill material included:

- ES-852
- ES-853

- ES-856

Radiological information related to the processing of these excavated soil survey units is summarized in Table 3-4 and the associated laboratory analytical results were discussed in the TU338 SUPR (Appendix D). The radiological and chemical analytical reports for the imported fill are provided in Appendix K.

With the concurrence of the DON, backfill operations were initiated on April 9, 2014 and were completed on April 21, 2014. An estimated 1,222 cubic yards of soil was placed in TU338 to grade followed by the application of road base material over the backfill trench. Backfill activities were performed in accordance with the HPNS Basewide Construction Specifications (TtEC 2012e). Parcel C Phase II project area site restoration activities are described in Section 9.0.

6.0 WORK AREA 34

Work Area 34 is located on the east side of Parcel C (Figure 1-3). It is bounded by Drydock No. 2 and Work Area 35 on the north, Parcel F and Ship Berths 1 through 3 on the east and south, and Work Areas 31 and 33 on the west. The radiological activities performed for Work Area 34 were limited to TU323, TU324, TU325, TU326, TU327, TU336, and TU337 (Figures 3-1 and 6-1). No further storm drain or sanitary sewer systems piping were excavated from Work Area 34 during the Parcel C Phase II time-critical removal action. The following sections summarize the Work Area 34 radiological work activities completed during the Parcel C Phase II project area time-critical removal action.

6.1 TRENCH SURVEY UNIT 323

TU323 is located in the southwest corner of Work Area 34 along Nimitz Avenue and adjacent to non-radiologically impacted Building 226 in Parcel C and north of Ship Berth 3 (Figures 3-1 and 6-1). TU323 connects to TU324 on the east, TU336 on the south, and TU338 on the west. The majority of TU323 is situated within IR Program Site IR-28. The chemicals of concern associated with IR-28 are listed in Table 3-9.

TU323 consists of two storm drain trench segments and eight sanitary sewer trench segments. As identified on Figure 6-1 and Table 3-1, these trench segments include:

Storm Drain Trench Segments

- 12-C34-00-8A
- 12-C34-28-5R

Sanitary Sewer Trench Segments

- 12-C34-00-1E
- 12-C34-00-1F
- 12-C34-00-1H
- 12-C34-00-8B
- 12-C34-00-8C
- 12-C34-00-8D
- 12-C34-28-5P
- 12-C34-28-5Q

Sanitary sewer trench segment 12-C34-00-1H continues into TU338 on the west and trench segment 12-C34-00-8B transitions into TU336 on the south. On the east, trench segment 12-C34-28-5P extends into TU324 and on the west continues into TU338. Storm drain trench segment 12-C34-28-5R transitions into TU324 on the east. With the exception of trench segments 12-C34-00-8A through -8D, each of the trench segments associated with TU323 was identified in the Design Plan (TtEC 2012d). Storm drain trench segment 12-C34-00-8A and sanitary sewer trench

segments 12-C34-00-8B and -8C were found during excavation of Manhole MH969. Trench segment 12-C34-00-8D was found during excavation of Manhole MH968. Although identified in the Design Plan, trench segments 12-C34-00-1G, -1I, and -1J could not be found after several excavation attempts during the Parcel C Phase II project area removal action.

6.1.1 TU323 Removal Action Activities

Excavation activities for TU323 were initiated on February 20, 2013 in sanitary sewer trench segment 12-C34-28-5P. A total of 63 truckloads of soil (approximately 756 cubic yards) were excavated from TU323 during the Parcel C Phase II project area removal action (Table 3-3). Soil generated during excavation of TU323 was transferred to RSY4 for radiological processing (Table 3-4). Following completion of the excavation on February 26, 2013, TU323 had an exposed surface area of 828 m² and was 472 linear feet in length (Table 3-1). The maximum excavated TU323 depths ranged between 2 feet and 7 feet bgs (Table 3-2).

Four manholes (MH968, MH969, MH970, and MH983) and 15 sections of pipe were removed from TU323 during the Parcel C Phase II project area removal action and placed on plastic pending further activities (Figure 6-1). The majority of the TU323 piping crumbled during removal and the debris was transferred along with the surrounding excavated soil to RSY4 for radiological processing. As indicated in Table 3-2, storm drain trench segments 12-C34-00-8A and 12-C34-28-5R contained 6-inch-diameter and 10-inch-diameter, respectively, VCP located at depths between 5 feet bgs and 7 feet bgs. Sanitary sewer trench segment 12-C34-00-8B contained 6-inch-diameter PVC located at a depth of approximately 2 feet bgs. Trench segment 12-C34-28-5P contained 12-inch-diameter RCP located at an estimated depth of 6 feet bgs. The remainder of the trench segments associated with TU323 contained 6-inch-diameter VCP located at depths ranging from 6 feet to 7 feet bgs.

An insufficient volume of sediment was available for sample collection and analysis in Manholes MH968, MH969, MH970, and MH983, or the pipe sections removed from TU323 during the Parcel C Phase II project area removal action. Consequently, there are no sediment sample analytical results associated with TU323.

Radiological survey activities were performed for Manholes MH968, MH969, MH970, and MH983, and 13 sections of pipe removed from trench segment 12-C34-28-5P during the Parcel C Phase II project area removal action (Table 3-6). No survey activities were performed for the estimated 35 linear feet of trench segment 12-C34-00-8A PVC pipe since these materials could not be properly surveyed; this PVC pipe was placed in LLRW bin GFLU0011531T1 on March 13, 2013 for off-site disposal by the DON radiological waste contractor. No elevated survey results were identified for Manholes MH968, MH969, and MH983, or the 13 sections of trench segment 12-C34-28-5P RCP (surveys HPS-PCPIPE-061013-076 and HPS-PCPIPE-061113-077). Based on these results, the brick material forming the 3 manholes and the 13 sections of RCP were

released and the debris transferred to the DON non-LLRW contractor for off-site disposal or recycling. The survey results for Manhole MH970 (survey HPS-PCPIPE-061113-077) identified a net beta/gamma static measurement above the release limit at 1,086 dpm/100 cm². Based on this result, the brick material forming Manhole MH970 was placed in LLRW bin GFLU001040T22 on July 2, 2013. In addition, a 12 foot section of trench segment 12-C34-00-8A VCP was placed in LLRW bin BFLU000190T18 on July 1, 2013 since it was directly connect to Manhole MH970. No survey activities were performed for this section of pipe during the Parcel C Phase II project area removal action. Copies of the radiological survey reports are presented in Appendix J.

6.1.2 TU323 Piping Remaining in Place

No known storm drain or sanitary sewer systems piping associated with TU323 remained in place within Parcel C following completion of the Phase II time-critical removal action activities.

6.1.3 TU323 Final Status Survey Summary

Eighteen systematic FSS soil samples were collected from the exposed sidewalls and bottom of TU323 and submitted to the laboratory for analysis on June 12, 2013 during the Parcel C Phase II project area removal action. No ROC concentrations above the release criteria specified in the AM (DON 2006) or the remediation goals established in the ROD (DON 2010) were identified in the TU323 FSS soil sample analytical results. The release criteria are identified in Tables 2-1 and 2-3, and the remediation goals are presented in Table 2-2. Figure 6-1 depicts the FSS soil sample collection locations in TU323. The range in the gamma scan survey and static survey count rates, and the FSS laboratory analytical reports were presented in Attachments 1 and 3, respectively, to the TU323 SUPR provided in Appendix E.

TU323 was defined for the FSS as the sum of the trench unit and the backfill material composed of a volume of imported fill. The average net residual ROC concentrations for material used as backfill in TU323 were 0.020 pCi/g for Cs-137, 0.152 pCi/g for Sr-90, and -0.141 pCi/g for Ra-226. The trench unit average net residual ROC concentrations were 0.020 pCi/g for Cs-137, 0.244 pCi/g for Sr-90, and -0.001 pCi/g for Ra-226. The net Ra-226 concentration (with background Ra-226 subtracted) was used to calculate the dose and risk. No background was subtracted from the Cs-137 or Sr-90 values since these radionuclides were not naturally occurring or expected due to nuclear weapons testing fallout at pipe depths.

RESRAD modeling using the larger of the MDL or reported net residual ROC and their decay product concentrations resulted in a dose of 0.5491 mrem/y with an increased cancer risk of 7.085×10^{-6} for the backfill material and 0.8579 mrem/y with an increased cancer risk of 1.099×10^{-5} for the trench unit (Yu et. al. 2001). These results were less than the NRC criterion of 25 mrem/y and the increased cancer risk falls within the EPA risk management range of 10^{-6} to 10^{-4} . The modeling parameters, values, and results were presented in Attachments 4 and 5 to the TU323 SUPR (Appendix E).

The results of the modeling efforts determined that the potential TU323 dose due to the net residual ROC and their decay product γ concentrations greater than or equal to the MDL was 0.8579 mrem/y with an increased cancer risk of 1.099×10^{-5} , which supports radiological free release. Qualitative ALARA analyses resulted in: 1) no FSS gamma survey measurements above the investigation levels, 2) none of the FSS sample results identified net residual ROC concentrations above the release criteria, 3) no air monitoring results exceeded 10 percent of the derived air concentration for members of the public, and 4) no personnel dosimetry badges processed identified doses above background levels. No further radiological action was recommended in the TU323 SUPR (Appendix E). Table 3-1 summarizes the activities performed during the Parcel C Phase II project area removal action to support the recommended radiological free release of TU323.

6.1.4 TU323 Backfill Activities

Imported fill was selected as the appropriate backfill material for TU323 because there were no suitable radiologically processed and released excavated soil survey units available. The radiological and chemical analytical reports for the imported fill are provided in Appendix K.

At the direction of the DON, backfill operations were initiated for TU323 on October 30, 2013 and completed on November 1, 2013. Although the draft TU323 SUPR and request for backfill was submitted to the ~~RASO~~-DON on August 15, 2013, concurrence with backfilling TU323 was not obtained until December 11, 2013 (Table 3-1). An estimated 826 cubic yards of soil was placed in TU323 to grade followed by the application of road base material over the backfilled trench. Backfill activities were performed in accordance with the HPNS Basewide Construction Specifications (TtEC 2012e). Parcel C Phase II project area restoration activities are described in Section 9.0.

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6.2 TRENCH SURVEY UNIT 324

Physically separated into two sections, TU324 is located in the southeast portion of Work Area 34 in Parcel C (Figures 3-1 and 6-1). The larger section of TU324 is situated along Nimitz Avenue to the north and west of non-radiologically impacted Building 225. The smaller section of TU324 is located east of Building 225. TU324 connects to TU336 on the north, TU325 on the east, and TU323 on the west. On the south, TU324 terminates within the 10 foot buffer zone surrounding Building 225. The majority of TU324 is situated within IR Program Site IR-28. The chemicals of concern associated with IR-28 are listed in Table 3-9.

TU324 is composed of eight storm drain trench segments and five sanitary sewer trench segments. As identified on Figure 6-1 and Table 3-1, these trench segments include:

Storm Drain Trench Segments

Sanitary Sewer Trench Segments

- 12-C34-00-1K
- 12-C34-00-1L
- 12-C34-00-1O
- 12-C34-00-1R
- 12-C34-28-5R
- 12-C34-28-5T
- 12-C34-28-5V
- 12-C34-28-5X
- 12-C34-00-1W
- 12-C34-28-5P
- 12-C34-28-5S
- 12-C34-28-5U
- 12-C34-28-5W

Sanitary sewer trench segment 12-C34-28-5P and storm drain trench segment 12-C34-28-5R extend into TU323 on the west. Storm drain trench segment 12-C34-28-5T transitions into TU336 on the north. Sanitary sewer trench segment 12-C34-28-5U continues into TU325 on the east. Each of the trench segments associated with TU324 was identified in the Design Plan (TtEC 2012d).

6.2.1 TU324 Removal Action Activities

Excavation activities for TU324 began on February 18, 2013 in sanitary sewer trench segment 12-C34-28-5U. A total of 97 truckloads of soil (approximately 1,164 cubic yards) were excavated from TU324 during the Parcel C Phase II project area removal action (Table 3-3). Soil generated during excavation of TU324 was transferred to RSY4 for radiological processing (Table 3-4). Following completion of the excavation on February 26, 2013, TU324 exhibited an exposed surface area of 938 m² and was 488 linear feet in length (Table 3-1). The maximum excavated TU324 depths ranged between 5 feet and 8 feet bgs (Table 3-2).

Five manholes (MH982, MH984, MH986, MH987, and MH1349) and 17 sections of pipe were removed from TU324 during the Parcel C Phase II project area removal action and placed on plastic pending further activities (Figure 6-1). Initially, Manhole MH1349 was listed as MH990; however, this designation was changed to avoid duplicate identification numbers. The majority of the TU324 piping disintegrated during removal and the debris was transferred along with the surrounding excavated soil to RSY4 for radiological processing. As indicated in Table 3-2, storm drain trench segment 12-C34-00-1L contained 8-inch-diameter VCP located at a depth of about 5 feet bgs. Storm drain trench segment 12-C34-00-1R contained 18-inch-diameter UCP located at a depth of approximately 6 feet bgs. Storm drain trench segments 12-C34-28-5T and -5V contained 18-inch-diameter VCP located at a depth of about 6 feet bgs. Sanitary sewer trench segments 12-C34-28-5P, -5S, and -5U contained 12-inch-diameter RCP located at depths between 5 feet and 7 feet bgs. The remaining trench segments contained 10-inch-diameter VCP located at depths ranging from 4 feet to 7 feet bgs.

A sufficient volume of sediment was available for sample collection and analysis in Manhole MH1349 (sample 12-PCMH990-007-01) during the Parcel C Phase II project area removal action (Table 3-5). No ROC concentrations above the release criteria were identified in the sediment sample analytical results. The sediment sample laboratory analytical report is provided in Appendix I.

Radiological survey activities were performed for Manholes MH982, MH984, MH986, MH987, and MH1349; two sections of pipe removed from trench segment 12-C34-28-5P; seven sections of pipe removed from trench segment 12-C34-28-5S; and, eight sections of pipe removed from trench segment 12-C34-28-5U during the Parcel C Phase II project area removal action (Table 3-6). No elevated survey results were identified for the five manholes (survey HPS-PCPIPE-061013-074) or the 17 sections of pipe (surveys HPS-PCPIPE-061013-075 and HPS-PCPIPE-061013-076). Based on these results, the concrete and brick materials forming the five manholes and the 17 sections of pipe were released and the debris transferred to the DON non-LLRW contractor for off-site disposal or recycling. Copies of the radiological survey reports are presented in Appendix J.

6.2.2 TU324 Piping Remaining in Place

No known storm drain or sanitary sewer systems piping associated with TU324 remained in place within Parcel C following completion of the Phase II time-critical removal action activities.

6.2.3 TU324 Final Status Survey Summary

A total of 18 systematic FSS soil samples were collected from the exposed sidewalls and bottom of TU324 and submitted to the laboratory for analysis on April 23, 2014 during the Parcel C Phase II project area removal action. No ROC concentrations above the release criteria specified in the AM (DON 2006) or the remediation goals established in the ROD (DON 2010) were identified in the TU324 FSS soil sample analytical results. The release criteria are identified in Tables 2-1 and 2-3, and the remediation goals are presented in Table 2-2. Figure 6-1 depicts the FSS soil sample collection locations in TU324. The range in the gamma scan survey and static survey count rates, and the FSS laboratory analytical reports were presented in Attachments 1 and 3, respectively, to the TU324 SUPR provided in Appendix E.

For the FSS, TU324 was defined as the sum of the trench unit and the backfill materials composed of both radiologically processed and released excavated soil survey units and a volume of imported fill. The average net residual ROC concentrations for materials used as backfill in TU324 were 0.021 pCi/g for Cs-137, 0.151 pCi/g for Sr-90, and -0.057 pCi/g for Ra-226. The trench unit average net residual ROC concentrations were 0.020 pCi/g for Cs-137, 0.155 pCi/g for Sr-90, and -0.071 pCi/g for Ra-226. The net Ra-226 concentration (with background Ra-226 subtracted) was used to calculate the dose and risk. No background was subtracted from the Cs-137 or Sr-90 values

since these radionuclides were not naturally occurring or expected due to nuclear weapons testing fallout at pipe depths.

RESRAD modeling using the larger of the MDL or net ROC and their decay product concentrations resulted in a dose of 0.6153 mrem/y with an increased cancer risk of 7.931×10^{-6} for the backfill material and 0.6286 mrem/y with an increased cancer risk of 8.091×10^{-6} for the trench unit (Yu et. al. 2001). These results were less than the NRC criterion of 25 mrem/y and the increased cancer risk falls within the EPA risk management range of 10^{-6} to 10^{-4} . The modeling parameters, values, and results were presented in Attachments 7 and 8 to the TU324 SUPR (Appendix E).

The results of the modeling efforts determined that the potential TU324 dose due to net residual ROC and their decay product concentrations greater than or equal to the MDL was 0.6286 mrem/y with an increased cancer risk of 8.091×10^{-6} , which supports radiological free release. Qualitative ALARA analyses resulted in: 1) no FSS gamma survey measurements above the investigation levels, 2) none of the FSS sample results identified net residual ROC concentrations above the release criteria, 3) no air monitoring results exceeded 10 percent of the derived air concentration for members of the public, and 4) no personnel dosimetry badges processed identified doses above background levels. No further radiological action was recommended in the TU324 SUPR (Appendix E). Table 3-1 summarizes the activities performed during the Parcel C Phase II project area removal action to support the recommended radiological free release of TU324.

6.2.4 TU324 Backfill Activities

Radiologically processed and released excavated soil survey units and a volume of imported fill were selected as the backfill materials for TU324. The excavated soil survey units selected as backfill material included:

- ES-795
- ES-798

Radiological information related to the processing of these excavated soil survey units is summarized in Table 3-4 and the associated laboratory analytical results are discussed in the TU324 SUPR (Appendix E). The radiological and chemical analytical reports for the imported fill are provided in Appendix K.

The **RASO-DON** concurred with backfilling TU324 on June 25, 2013 (Table 3-1). Backfill operations commenced on July 1, 2013 and were completed on July 3, 2013. An estimated 935 cubic yards of soil was placed in TU324 to grade followed by the application of road base material over the backfilled trench. Backfill activities were performed in accordance with the HPNS

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Basewide Construction Specifications (TtEC 2012e). Parcel C Phase II project area restoration activities are described in Section 9.0.

6.3 TRENCH SURVEY UNIT 325

Physically separated into three distinct sections, TU325 is located in the southeast portion of Work Area 34 within Parcel C (Figures 3-1 and 6-1). The largest section of TU325 is located adjacent to the southeast corner of radiologically impacted Building 211 and connects to TU336 on the west and TU303 on the east, which was excavated during the first phase of the Parcel C removal action. One of the smaller sections of TU325 is located to the west of Ship Berth 2 and south of Building 211, and terminates at manhole MH993 on the north and connects to TU303 on the west. The smallest trench section of TU325 is located along Nimitz Avenue to the northeast of Building 225, and terminates at TU 303 on the north and TU324 on the west. TU325 is situated within IR Program Site IR-28. The chemicals of concern associated with IR-28 are listed in Table 3-9.

TU325 is composed of 12 storm drain trench segments and 2 sanitary sewer trench segments. As identified on Figure 6-1 and Table 3-1, these trench segments include:

Storm Drain Trench Segments

- 12-211-28-4H
- 12-211-28-4L
- 12-211-28-4M
- 12-211-28-4N
- 12-C34-28-4H
- 12-C34-28-4K
- 12-C34-28-4L
- 12-C34-28-4M
- 12-C34-28-4N
- 12-C34-28-4O
- 12-C34-28-5Z
- 12-C34-28-8A

Sanitary Sewer Trench Segments

- 12-C34-28-4P
- 12-C34-28-5U

Storm drain trench segment 12-C34-28-4K and sanitary sewer trench segment 12-C34-28-4P continue into TU336 on the west. Sanitary sewer trench segment 12-C34-28-5U transitions into TU 324 on the west. With the exception of storm drain trench segment 12-C34-28-8A, each of the trench segments associated with TU325 was identified in the Design Plan (TtEC 2012d). Trench segment 12-C34-28-8A was found during the excavation of manhole MH991. Although

identified in the Design Plan (TtEC 2012d), trench segment 12-C34-28-5Z could not be found after several excavation attempts and was likely removed by the DON at some time in the past.

6.3.1 TU325 Removal Action Activities

Excavation activities for TU325 were initiated on February 15, 2013 in storm drain trench segment 12-211-28-4H. A total of 64 truckloads of soil (approximately 768 cubic yards) were excavated from TU325 during the Parcel C Phase II project area removal action (Table 3-3). Soil generated during excavation of TU325 was transferred to RSY4 for radiological processing (Table 3-4). Following completion of the excavation on February 26, 2013, TU325 exhibited an exposed surface area of 927 m² and was 562 linear feet in length (Table 3-1). The maximum excavated TU325 depths ranged between 2 feet and 8 feet bgs (Table 3-2).

A total of four manholes (MH991, MH993, MH995, and MH998) and three sections of pipe were removed from TU325 during the Parcel C Phase II project area removal action and placed on plastic pending further activities (Figure 6-1). The majority of the TU325 piping disintegrated upon removal and the debris was transferred along with the surrounding excavated soil to RSY4 for radiological processing. As indicated in Table 3-2, storm drain trench segments 12-211-28-4H and -4M contained 2-inch-diameter and 4-inch-diameter steel pipe located at depths between 2 feet and 3 feet bgs. Storm drain trench segments 12-211-28-4L and -4N contained 6-inch-diameter CIP located at depths between 2 feet and 5 feet bgs. Storm drain trench segments 12-C34-28-4H and -4M contained 2-inch-diameter steel pipe located at depths between 2 feet and 5 feet bgs. Sanitary sewer trench segment 12-C34-28-5U contained 12-inch-diameter RCP and storm drain trench segment 12-C34-28-8A contained 10-inch-diameter UCP. The pipe in these trench segments were located at a depth of approximately 5 feet bgs. The remainder of the TU325 trench segments contained 6-inch-diameter to 12-inch-diameter VCP located at depths between 2 feet and 7 feet bgs.

An insufficient volume of sediment was available for sample collection and analysis in manholes MH991, MH993, MH995, and MH998, or the two pipe sections removed from TU325 during the Parcel C Phase II project area removal action. Consequently, there are no sediment sample analytical results associated with TU325.

Radiological survey activities were performed for manholes MH991, MH993, and MH995, and three sections of pipe removed from trench segment 12-C34-28-5U during the Parcel C Phase II removal action activities (Table 3-6). No elevated survey results (surveys HPS-PCPIPE-061013-075 and HPS-PCPIPE-061113-077) were identified for these manholes or pipe sections. Based on these results, the concrete and brick materials forming the manholes and the three sections of pipe removed from trench segment 12-C34-28-5U were released and the debris transferred to the DON non-LLRW contractor for off-site disposal or recycling. Copies of the radiological survey reports are presented in Appendix J.

Surveys were performed and eight swipe samples were collected from TU325 in situ pipe sections associated with trench segments 12-C34-28-4K and 12-C34-28-4P, and exiting Building 211 floor drain lines 12-211-28-4H and 12-211-28-4M. Survey results for these pipe sections (survey PCPIPE-071913-081) identified elevated net (fixed and removable) beta/gamma static measurements with maximum levels recorded as: 12-211-28-4H (1,269 dpm/100 cm²), 12-211-28-4M (1,920 dpm/100 cm²), 12-C34-28-4K (2,216 dpm/100 cm²), and 12-C34-28-4P (3,002 dpm/100 cm²). The survey results for the 12-211-28-4M steel pipe identified net beta/gamma static measurements at 1,628 dpm/100 cm² and 1,920 dpm/100 cm². Since the DON did not include these pipes in the Parcel C Phase II removal action, the elevated pipes were capped to eliminate the possibility of contamination entering TU325 from Building 211.

Although no survey activities were performed during the Parcel C Phase II removal action for manhole MH998, the materials forming MH998 were placed in LLRW bin GFLU001117T1 on March 13, 2013 due to the presence of firebrick.

Initially, survey activities were performed and a total of 18 systematic soil samples were collected from the exposed sides and bottom of TU325 on May 29, 2013 and submitted to the laboratory for screening analysis. The screening analytical results identified the presence of Ra-226 concentrations above the release limit in five soil samples ranging from 1.568 pCi/g to 2.207 pCi/g. In addition, one investigative soil sample was collected and analyzed to determine the presence of NORM fill material in TU325. The DON concluded that the persistence of relatively elevated Ra-226 activity was likely due to the presence of NORM fill materials as described in Section 2.5.8. Figure 6-2 depicts the approximate locations of the Ra-226 soil samples in TU325 associated with the NORM fill materials.

6.3.2 TU325 Piping Remaining in Place

No known storm drain or sanitary sewer systems piping associated with TU325 remained in place within Parcel C following completion of the Phase II time-critical removal action activities.

6.3.3 TU325 Final Status Survey Summary

The 18 systematic soil samples collected from the exposed sidewalls and bottom of TU325 on May 29, 2013 were submitted to the laboratory for definitive analysis during the Parcel C Phase II project area removal action. No ROC concentrations above the release criteria specified in the NORM Abstract (Appendix A) were identified in the TU325 FSS soil sample analytical results for the . The NORM Abstract release criteria are specified in Table 2-4. Figure 6-1 depicts the FSS soil sample collection locations in TU325. The range in the gamma scan survey and static survey count rates were presented in Attachment 1 to the TU325 SUPR provided in Appendix E. The laboratory analytical reports for the FSS soil samples were included in Attachment 3 to the TU325 SUPR.

TU325 was defined for the FSS as the sum of the trench unit and the backfill materials composed of a volume of imported fill. The average net residual ROC concentrations for materials used as backfill were 0.020 pCi/g for Cs-137, 0.152 pCi/g for Sr-90, and -0.141 pCi/g for Ra-226. The trench unit average net residual ROC concentrations were 0.024 pCi/g for Cs-137, 0.145 pCi/g for Sr-90, and 0.210 pCi/g for Ra-226. The net Ra-226 concentration (with background Ra-226 subtracted) was used to calculate dose and risk. No background was subtracted from the Cs-137 or Sr-90 values since these radionuclides were not naturally occurring or expected due to nuclear weapons testing fallout at pipe depths.

RESRAD modeling using the larger of the MDL or net residual ROC and their decay product concentrations resulted in a dose of 0.6104 mrem/y with an increased cancer risk of 7.860×10^{-6} for the backfill material and 4.038 mrem/y with an increased cancer risk of 6.305×10^{-5} for the trench unit (Yu et. al. 2001). These results were less than the NRC criterion of 25 mrem/y and the increased cancer risk falls within the EPA risk management range of 10^{-6} to 10^{-4} . The modeling parameters, values, and results were presented in Attachments 4 and 5 to the TU325 SUPR (Appendix E).

The results of the modeling efforts determined that the potential TU325 dose due to net residual ROC and their decay product concentrations greater than or equal to the MDL was 4.038 mrem/y with an increased cancer risk of 6.305×10^{-5} , which supports radiological free release. Qualitative ALARA analyses resulted in: 1) no FSS gamma survey measurements above the investigation levels, 2) none of the FSS sample results identified residual net residual ROC and their decay product concentrations above the release criteria specified in Table 2-4, 3) no air monitoring results exceeded 10 percent of the derived air concentration for members of the public, and 4) no personnel dosimetry badges processed identified doses above background levels. No further radiological action was recommended in the TU325 SUPR (Appendix E). Table 3-1 summarizes the activities performed during the Parcel C Phase II project area removal action to support the recommended radiological free release of TU325.

6.3.4 TU325 Backfill Activities

A volume of imported fill was selected as the appropriate backfill material for TU325. The radiological and chemical analytical reports for the imported fill are provided in Appendix K.

With the concurrence of the DON on October 3, 2013, backfill operations were initiated on November 4, 2013 and completed on November 5, 2013. The ~~RASO-DON~~ concurred with backfilling TU325 on December 11, 2013. An estimated 770 cubic yards of imported fill was placed in TU325 to grade followed by the application of road base material over the backfilled trench. Backfill activities were performed in accordance with the HPNS Basewide Construction Specifications (TtEC 2012e). Parcel C Phase II project area site restoration activities are described in Section 9.0.

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6.4 TRENCH SURVEY UNIT 326

TU326 is located on the west side of Work Area 34 in Parcel near the intersection of Spear Avenue and Lockwood Street and to the west of radiologically impacted Building 253 (Figures 3-1 and 6-1). TU326 connects to TU197 and TU243, excavated during the first phase of the Parcel C removal action, on the north and TU327 on the south. TU326 terminates on the east at radiologically impacted Building 253. TU326 is situated within IR Program Site IR-28. The chemicals of concern associated with IR-28 are listed in Table 3-9.

TU326 is composed of five storm drain trench segments and seven sanitary sewer trench segments. As identified on Figure 6-1 and Table 3-1, these trench segments include:

<u>Storm Drain Trench Segments</u>	<u>Sanitary Sewer Trench Segments</u>
<ul style="list-style-type: none">• 12-253-28-3M• 12-253-28-8A• 12-C34-28-1O• 12-C34-28-3D• 12-C34-28-8E	<ul style="list-style-type: none">• 12-253-28-3H• 12-C34-28-1M• 12-C34-28-3A• 12-C34-28-3B• 12-C34-28-3C• 12-C34-28-8B• 12-C34-28-8C

Storm drain trench segment 12-C34-28-3D transitions into TU327 on the south. Sanitary sewer trench segments 12-253-28-3H and 12-C34-28-3C extend into TU327 on the south. With the exception of 12-2253-28-8A and 12-C34-28-8B, -8C, and -8E, each of the trench segments associated with TU326 was identified in the Design Plan (TtEC 2012d). Trench segment 12-253-28-8A was found during excavation of trench segment 12-C34-28-1O. Trench segments 12-C34-28-8B and -8E were found during excavation of manhole MH1345. Trench segment 12-C34-28-8C was found during excavation of manhole MH1046 and trench segment 12-C34-28-3B. Although identified in the Design Plan (TtEC 2012d), trench segment 12-C34-28-6B could not be found after several excavation attempts and was likely removed by the DON at some time in the past.

6.4.1 TU326 Removal Action Activities

Excavation activities for TU326 began on April 30, 2013 in sanitary sewer trench segment 12-C34-28-3A. A total of 109 truckloads of soil (approximately 1,308 cubic yards) were excavated from TU326 during the Parcel C Phase II project area removal action (Table 3-3). Soil generated during excavation of TU326 was transferred to RSY4 for radiological processing (Table 3-4). Following completion of the excavation on August 12, 2013, TU326 had an expose surface area

of 922 m² and was 511 linear feet in length (Table 3-1). The maximum excavated TU326 depths ranged between 4 feet and 9 feet bgs (Table 3-2).

Manholes MH1034, MH1046, and MH1345 and 13 sections of pipe were removed from TU326 during the Parcel C Phase II project area removal action and placed on plastic pending further activities (Figure 6-1). The majority of the TU326 piping crumbled upon removal and the debris was transferred along with the surrounding excavated soil to RSY4 for radiological processing. As indicated in Table 3-2, trench segments 12-253-28-3M and -8A contained 15-inch diameter VCP located at depths between 5 feet and 6 feet bgs. Storm drain trench segments 12-253-28-8A and 12-C34-28-8E contained 6-inch-diameter VCP located at depths between 5 feet and 8 feet bgs. Trench segments 12-C34-28-3A and -3C contained 10-inch-diameter VCP located between 6 feet and 7 feet bgs. Sanitary sewer trench segments 12-C34-28-3B and -8C contained CIP located at a depth of approximately 4 feet bgs. The remainder of the trench segments contained 4-inch-diameter to 27-inch-diameter VCP at depths ranging from 4 feet to 8 feet bgs.

An insufficient volume of sediment was available for sample collection and analysis in manholes MH1034, MH1046, and MH1345 and the 13 sections of TU326 pipe removed from TU326 during the Parcel C Phase II project area removal action. Consequently, there are no sediment sample analytical results associated with TU326.

Radiological survey activities were performed for manholes MH1034, MH1046, and MH1345, and 11 sections of pipe removed from trench segment 12-C34-28-3D during the Parcel C Phase II removal action activities (Table 3-6). No elevated survey results (survey HPS-PCPIPE-072413-084) were identified for the three manholes. Based on these results, the brick and concrete materials forming manholes MH1034, MH1046, and MH1345 were released and the debris transferred to the DON non-LLRW contractor for off-site disposal or recycling. The survey results for the 11 section of pipe removed from trench segment 12-C34-28-4D (survey HPS-PCPIPE-053013-073) identified elevated net beta/gamma static measurements for four of the pipe sections removed from trench segment 12-C34-28-3D with a maximum level of 1,660 dpm/100 cm². Although no elevated survey results were identified for 7 of the 11 sections of trench segment 12-C34-28-4D pipe, all 11 sections were placed in LLRW bins on June 12, 2013 for off-site disposal by the DON radiological waste contractor. The 4-inch-diameter sections of CIP removed from trench segments 12-C34-28-3B and -8C were placed in LLRW bin GFLU002018T2 on May 1, 2013 because proper surveys could not be performed due to the narrow diameter of the pipes. Copies of the radiological survey reports are presented in Appendix J.

Survey activities were performed and two swipe samples were collected from a pipe section exiting the Building 253 floor drain line to trench segment 12-253-28-8A. Survey results for this pipe section (HPS-PCPIPE-071913-081) identified elevated net (fixed and removable) beta/gamma static measurements with a maximum recorded level of 1,727 dpm/ 100 cm². Since the DON did

not include this pipe in the Parcel C Phase II removal action, the elevated pipe was capped to eliminate the possibility of contamination from Building 253 entering TU326.

Initially, survey activities were performed and a total of 18 systematic soil samples were collected from the exposed sides and bottom of TU326 on May 20, 2013 and submitted to the laboratory for screening analysis. Due to the presence of elevated gamma static measurements, two investigative soil samples were also collected and analyzed. The analytical results identified a Ra-226 radioactivity concentration at 1.676 pCi/g in one investigative soil sample, which did not exceed the NORM Abstract Ra-226 release limit (Table 2-4). In addition, one investigative soil sample was collected and analyzed to determine the presence of NORM fill material in TU326. The DON concluded that the persistence of relatively elevated Ra-226 activity was likely due to the presence of NORM fill materials as described in Section 2.5.8. Figure 6-2 depicts the approximate locations of the Ra-226 soil sample in TU326 associated with the NORM fill materials.

6.4.2 TU326 Piping Remaining in Place

No known storm drain or sanitary sewer systems piping associated with TU326 remained in place within Parcel C following completion of the Phase II time-critical removal action activities.

6.4.3 TU326 Final Status Survey Summary

The 18 systematic soil samples collected from the exposed sidewalls and bottom of TU326 on May 20, 2013 were submitted to the laboratory for definitive analysis during the Parcel C Phase II project area removal action. No ROC concentrations above the release criteria specified in the NORM Abstract (Appendix A) were identified in the TU326 FSS soil sample analytical results. The NORM Abstract release criteria are specified in Table 2-4. Figure 6-1 depicts the FSS soil sample collection locations in TU326. The range in the gamma scan survey and static survey count rates were presented in Attachment 1 to the TU326 SUPR provided in Appendix E. The laboratory analytical reports for the FSS soil samples were included in Attachment 3 to the TU326 SUPR.

For the FSS, TU326 was defined as the sum of the trench unit and the backfill materials composed of a volume of imported fill. The average net residual ROC concentrations for materials used as backfill were 0.022 pCi/g for Cs-137, 0.127 pCi/g for Sr-90, and -0.108 pCi/g for Ra-226. The trench unit average net residual ROC concentrations were 0.021 pCi/g for Cs-137, 0.175 pCi/g for Sr-90, and -0.155 pCi/g for Ra-226. The net Ra-226 concentration (with background Ra-226 subtracted) was used to calculate dose and risk. No background was subtracted from the Cs-137 or Sr-90 values since these radionuclides were not naturally occurring or expected due to nuclear weapons testing fallout at pipe depths.

RESRAD modeling using the larger of the MDL or reported net residual ROC and their decay product concentrations resulted in a dose of 0.5178 mrem/y with an increased cancer risk of 6.705×10^{-6} for the backfill material and 0.6952 mrem/y with an increased cancer risk of 8.940×10^{-6}

for the trench unit (Yu et. al. 2001). These results were less than the NRC criterion of 25 mrem/y and the increased cancer risk falls within the EPA risk management range of 10^{-6} to 10^{-4} . The modeling parameters, values, and results were presented in Attachments 4 and 5 to the TU326 SUPR (Appendix E).

The results of the modeling efforts determined that the potential TU326 dose due to net residual ROC and their decay product concentrations greater than or equal to the MDL was 0.6952 mrem/y with an increased cancer risk of 8.940×10^{-6} , which supports radiological free release. Qualitative ALARA analyses resulted in: 1) no FSS gamma survey measurements above the investigation levels, 2) none of the FSS sample results identified net residual ROC and their decay product concentrations above the release criteria specified in Table 2-4, 3) no air monitoring results exceeded 10 percent of the derived air concentration for members of the public, and 4) no personnel dosimetry badges processed identified doses above background levels. No further radiological action was recommended in the TU326 SUPR (Appendix E). Table 3-1 summarizes the activities performed during the Parcel C Phase II project area removal action to support the recommended radiological free release of TU326.

6.4.4 TU326 Backfill Activities

A volume of imported fill was selected as the appropriate backfill material for TU326. The radiological and chemical analytical reports for the imported fill are provided in Appendix K.

With the concurrence of the DON on October 3, 2013, backfill operations for TU326 began on October 23, 2013 and were completed on October 28, 2013. An estimated 812 cubic yards of imported fill was placed in TU326 to grade followed by the application of road base material over the backfilled trench. Backfill activities were performed in accordance with the HPNS Basewide Construction Specifications (TfEC 2012e). Parcel C Phase II project area site restoration activities are described in Section 9.0.

6.5 TRENCH SURVEY UNIT 327

Physically separated into three distinct sections, TU327 is located on the west side of Work Area 34 in Parcel C adjacent to the west of radiologically impacted Building 253 and east of Building 228 (Figures 3-1 and 6-1). The largest section of TU327 extends westward and terminates within the 10-foot buffer zones surrounding Buildings 228 and 281. This section of TU327 connects to TU326 on the north and TU337 on the south. One small section of TU327 is located on the east side of Building 228 and terminates at manhole MH977 on the north and connects to TU337 on the south. The smallest section of TU327 is located at the southeast corner of Building 228 and connects to TU315 on the south. TU327 is situated within IR Program Site IR-28. The chemicals of concern associated with IR-28 are listed in Table 3-9.

TU327 is composed of seven storm drain trench segments and eight sanitary sewer trench segments. As identified on Figure 6-1 and Table 3-1, these trench segments include:

Storm Drain Trench Segments

- 12-253-28-3J
- 12-C33-28-3E
- 12-C33-28-3F
- 12-C33-28-8E
- 12-C34-28-3D
- 12-C34-28-3E
- 12-C34-28-3F

Sanitary Sewer Trench Segments

- 12-253-28-3H
- 12-253-28-3I
- 12-C33-28-3D
- 12-C33-28-3N
- 12-C33-28-8F
- 12-C34-28-3C
- 12-C34-28-3G
- 12-C34-28-8D

Storm drain trench segment 12-253-28-3J connects to TU337 on the south, sanitary sewer trench segment 12-C253-28-3H transitions into TU326 on the north and 12-253-28-3I extends into TU337 on the south. Trench segments 12-C34-28-3C and -3D transition into TU326 on the north. Trench segments 12-C33-28-3F and -8F extend into TU337 on the south. Sanitary sewer trench segment 12-C33-28-3N connects to TU315 on the west. With the exception of trench segments 12-C33-28-8E, 12-C33-28-8F, and 12-C34-28-8D, each of the trench segments associated with TU327 was identified in the Design Plan (TtEC 2012d). Trench segment 12-C33-28-8E was found during excavation of trench segment 12-C33-28-3F and trench segment 12-C33-28-8F was found during excavation of manhole MH973. Sanitary sewer trench segment 12-C34-28-8D was found during excavation of trench segment 12-C34-28-3E.

6.5.1 TU327 Removal Action Activities

Excavation activities for TU327 commenced on May 2, 2013 in trench segment 12-C34-28-3E. A total of 82 truckloads of soil (approximately 984 cubic yards) were excavated from TU327 during the Parcel C Phase II project area removal action (Table 3-3). Soil generated during excavation of TU327 was transferred to RSY4 for radiological processing (Table 3-4). Following completion of the excavation on August 15, 2013, TU327 exhibited an exposed surface area of 710 m² and was 430 linear feet in length (Table 3-1). The maximum excavated TU327 depths ranged between 4 feet and 10 feet bgs (Table 3-2).

Six manholes (MH973, MH976, MH977, MH979, MH980, and MH981) and five sections of pipe were removed from TU327 during the Parcel C Phase II project area removal action and placed on plastic pending further activities (Figure 6-1). The majority of the TU327 piping disintegrated upon removal and the debris was transferred along with the surrounding excavated soil to RSY4 for radiological processing. As indicated in Table 3-2, sanitary sewer trench segments 12-253-28-

3H and -3I contained 18-inch-diameter VCP and storm drain trench segment 12-253-28-3J contained 27-inch-diameter VCP. The pipe in these three trench segments was found at depths between 7 feet and 8 feet bgs. Storm drain trench segments 12-C33-28-3E and 12-C34-28-3E contained 6-inch-diameter CIP located at depths between 4 feet and 5 feet bgs. Storm drain trench segment 12-C34-28-3F contained 10-inch-diameter UCP located at depths between 6 feet and 8 feet bgs. Storm drain trench segment 12-C34-28-3D contained 27-inch-diameter VCP located at a depth of approximately 7 feet bgs. The remainder of the trench segments contained 4-inch-diameter to 10-inch-diameter VCP located at depths between 5 feet and 10 feet bgs.

An insufficient volume of sediment was available for sample collection and analysis in the six TU327 manholes or the five sections of pipe during the Parcel C Phase II project area removal action. Consequently, there are no sediment sample analytical results associated with TU327.

Radiological survey activities were performed for manholes MH973, MH976, MH977, MH979, MH980, and MH981, two sections of VCP removed from trench segment 12-C34-28-3D, and one section of UCP removed from trench segment 12-C34-28-3F during the Parcel C Phase II removal action (Table 3-6). No elevated survey results (surveys HPS-PCPIPE-053013-073, HPS-PCPIPE-072413-084 and HPS-PCPIPE-072513-085) were identified for the six manholes, the two sections of pipe removed from trench segment 12-C34-28-3D, or the UCP section removed from trench segment 12-C34-28-3F. Based on these results, the concrete and brick materials forming manholes MH973, MH976, MH977, MH979, MH980, and MH981, and the section of UCP were released and the debris transferred to the DON non-LLRW contractor for off-site disposal or recycling. Although the survey results for the two sections of VCP removed from trench segment 12-C34-28-3D (survey HPS-PCPIPE-053013-073) did not indicate the presence of contamination, both sections were placed in LLRW bins on June 12, 2013 because of the number of elevated survey results from the upstream trench segment 12-C34-28-3D pipes associated with TU326.

Proper surveys could not be performed for the 6-inch-diameter CIP removed from trench segments 12-C33-28-3E and 12-C34-28-3E due to the small diameter of the pipe. The section of pipe removed from trench segment 12-C33-28-3E was placed in LLRW bin GFLU001183T19 on May 6, 2013 and the section of pipe removed from trench segment 12-C34-28-3E was placed in LLRW bin GFLU001028T2 on May 2, 2013 for off-site disposal by the DON radiological waste contractor.

Initially, survey activities were performed and elevated gamma scan readings were identified. A total of 18 systematic soil samples were collected from the exposed sidewalls and bottom of TU327 and an investigative soil sample was collected from the elevated gamma scan readings location on May 21, 2013 and submitted to the laboratory for screening analysis. The analytical results identified Ra-226 radioactivity concentrations ranging from 1.621 pCi/g to 2.227 pCi/g in three of the systematic soil samples and in the investigative soil sample (2.259 pCi/g). One additional

investigative soil sample was collected on June 17, 2013 and submitted to the laboratory for screening analysis. The analytical results identified the presence of Ra-226 at 2.057 pCi/g in the soil sample. In addition, two investigative soil samples were collected and analyzed to determine the presence of NORM fill material in TU327 that may have been the source for the elevated Ra-226 analytical results. The DON concluded that the persistence of relatively elevated Ra-226 activity was likely due to the presence of NORM fill materials as described in Section 2.5.8. Figure 6-2 depicts the approximate locations of the Ra-226 soil samples in TU327 associated with the NORM fill materials.

6.5.2 TU327 Piping Remaining in Place

No known storm drain or sanitary sewer systems piping associated with TU327 remained in place within Parcel C following completion of the Phase II time-critical removal action activities.

6.5.3 TU327 Final Status Survey Summary

The 18 systematic soil samples collected from the exposed sidewalls and bottom of TU327 on May 21, 2013 were submitted to the laboratory for definitive analysis during the Parcel C Phase II project area removal action. No ROC concentrations above the release criteria specified in the NORM Abstract (Appendix A) were identified in the TU327 FSS soil sample analytical results. The NORM abstract release criteria are specified in Table 2-4. Figure 6-1 depicts the FSS soil sample collection locations in TU327. The range in the gamma scan survey and static survey count rates were presented in Attachment 1 to the TU327 SUPR provided in Appendix E. The laboratory analytical reports for the FSS soil samples were included in Attachment 3 to the TU327 SUPR.

TU327 was defined for the FSS as the sum of the trench unit and the backfill materials composed of a volume of imported fill. The average net residual ROC concentrations for materials used as backfill were 0.022 pCi/g for Cs-137, 0.118 pCi/g for Sr-90, and -0.096 pCi/g for Ra-226. The trench unit average net residual ROC concentrations were 0.020 pCi/g for Cs-137, 0.150 pCi/g for Sr-90, and 0.140 pCi/g for Ra-226. The net Ra-226 concentration (with background Ra-226 subtracted) was used to calculate dose and risk. No background was subtracted from the Cs-137 or Sr-90 values since these radionuclides were not naturally occurring or expected due to nuclear weapons testing fallout at pipe depths.

RESRAD modeling using the larger of the MDL or the net residual ROC concentrations resulted in a dose of 0.382 mrem/y with an increased cancer risk of 4.985×10^{-6} for the backfill material and 2.42 mrem/y with an increased cancer risk of 3.853×10^{-5} for the trench unit (Yu et. al. 2001). These results were less than the NRC criterion of 25 mrem/y and the increased cancer risk falls within the EPA risk management range of 10^{-6} to 10^{-4} . The modeling parameters, values, and results were presented in Attachments 4 and 5 to the TU327 SUPR (Appendix E).

The results of the modeling efforts determined that the potential TU327 dose due to the net residual ROC and their decay product concentrations greater than or equal to the MDL was 2.42 mrem/y with an increased cancer risk of 3.853×10^{-5} , which supports radiological free release. Qualitative ALARA analyses resulted in: 1) no FSS gamma survey measurements above the investigation levels, 2) none of the FSS sample results identified net residual ROC and their decay product concentrations above the release criteria specified in Table 2-4, 3) no air monitoring results exceeded 10 percent of the derived air concentration for members of the public, and 4) no personnel dosimetry badges processed identified doses above background levels. No further radiological action was recommended in the TU327 SUPR (Appendix E). Table 3-1 summarizes the activities performed during the Parcel C Phase II project area removal action to support the recommended radiological free release of TU327.

6.5.4 TU327 Backfill Activities

A volume of imported fill was selected as the appropriate backfill material for TU327. The radiological and chemical analytical reports for the imported fill are provided in Appendix K.

With the concurrence of the DON on October 3, 2013, backfill operations for TU327 began on October 22, 2013 and were completed on October 25, 2013. An estimated 846 cubic yards of imported fill was placed in TU327 to grade followed by the application of road base material over the backfill trench. Backfill activities were performed in accordance with the HPNS Basewide Construction Specifications (TtEC 2012e). Parcel C Phase II project area site restoration activities are described in Section 9.0.

6.6 TRENCH SURVEY UNIT 336

Physically separated into three distinct sections, TU336 is located in the southwestern portion of Work Area 34, adjacent to radiologically impacted Building 253 and south of radiologically impacted Building 211 (Figures 3-1 and 6-1). The largest section of TU336 extends from manhole MH989 near the intersection of Buildings 211 and 253 southward where it connects to TU324. On the west, this section of TU336 terminates on the south side of Building 253. The smaller section of TU336 is located along the south side of Building 253. The smallest section of TU336 is located on the south side of Building 211 and connects to TU325 on the east. The majority of TU336 is situated within IR Program Site IR-28. The chemicals of concern associated with IR-28 are listed in Table 3-9.

TU336 is composed of 15 storm drain trench segments and 11 sanitary sewer trench segments. As identified on Figure 6-1 and Table 3-1, these trench segments include:

Storm Drain Trench Segments

- 12-211-28-8A

Sanitary Sewer Trench Segments

- 12-253-28-5G

- 12-253-28-4S
- 12-253-28-8B
- 12-253-28-8L
- 12-253-28-8M
- 12-C34-28-4K
- 12-C34-28-4R
- 12-C34-28-4S
- 12-C34-28-5T
- 12-C34-28-8F
- 12-C34-28-8H
- 12-C34-28-8I
- 12-C34-28-8J
- 12-C34-28-8L
- 12-C34-28-8M
- 12-253-28-5I
- 12-253-28-5O
- 12-253-28-8C
- 12-C34-00-8B
- 12-C34-28-4P
- 12-C34-28-5G
- 12-C34-28-5I
- 12-C34-28-5K
- 12-C34-28-5O
- 12-C34-28-8G

Sanitary sewer trench segment 12-C34-00-8B connects to TU323 on the north and terminates on the south at the ship service structure. Trench segments 12-C34-28-4K and -4P transition into TU325 on the east. Storm drain trench segment 12-C34-28-5T extends into TU324 on the south. With the exception of trench segments 12-211-28-8A; 12-253-28-8B, -8C, and -8L; 12-C34-00-8B; and 12-C34-28-8F through -8J and -8M, each of the trench segments associated with TU336 was identified in the Design Plan (TtEC 2012d). Trench segments 12-211-28-8A and 12-C34-28-8J were found during excavation of trench segments 12-C34-28-4K and -4P. Trench segments 12-253-28-8B, 12-253-28-8L, 12-C34-28-8F, and 12-C34-28-8L were found during excavation of manhole MH989. Trench segment 12-253-28-8C was found during excavation of 12-C34-28-5O. Trench segments 12-253-28-8M and 12-C34-28-8M were found during excavation of trench segment 12-C34-28-4R and manhole MH988. Although identified in the Design Plan (TtEC 2012d), trench segments 12-253-28-5H and 12-C34-28-5H could not be found after several excavation attempts.

6.6.1 TU336 Removal Action Activities

Excavation activities for TU336 were initiated on February 15, 2013 in trench segment 12-C34-28-4K. A total of 78 truckloads of soil (approximately 936 cubic yards) were excavated from TU336 during the Parcel C Phase II project area removal action (Table 3-3). Soil generated during excavation of TU336 was transferred to RSY4 for radiological processing (Table 3-4). Following completion of the excavation on October 1, 2013, TU336 had an exposed surface area of 782 m²

and was 526 linear feet in length (Table 3-1). The maximum excavated TU336 depths ranged between 3 feet and 8 feet bgs (Table 3-2).

Manholes MH985, MH988, MH989, and MH1350 and 15 sections of pipe were removed from TU336 during the Parcel C Phase II project area removal action and placed on plastic pending further activities (Figure 6-1). The majority of the TU336 piping crumbled upon removal and the debris was transferred along with the surrounding excavated soil to RSY4 for radiological processing. As indicated in Table 3-2, storm drain trench segments 12-211-28-8A, 12-253-28-8M, 12-C34-28-8H, 12-C34-28-8J, and 12-C34-28-8M contained 6-inch-diameter VCP located at depths ranging from 3 feet to 8 feet bgs. Storm drain trench segment 12-253-28-8B contained 8-inch-diameter CIP located at a depth of approximately 4 feet bgs. Sanitary sewer trench segment 12-C34-00-8B contained 6-inch-diameter PVC pipe located at a depth of 3 feet bgs. The remainder of the TU336 trench segments contained 6-inch-diameter to 18-inch-diameter VCP located at depths between 3 feet and 7 feet bgs (Table 3-2).

As indicated in Table 3-5, a sufficient volume of sediment for sample collection and analysis was found in manholes MH988 (sample 12-PCMH988-012-01) and MH989 (sample 12-PCMH989-011-01), one section of pipe removed from trench segment 12-C34-00-8B (sample 12-PCPI-0018-01), and one section of pipe removed from trench segment 12-C34-28-8L (sample 12-PCPI-0017-01). No ROC concentrations above the release criteria were identified in the sediment samples collected from manhole MH988 or the pipe section removed from trench segment 12-C34-00-8B. Although no ROC concentrations above the release criteria were identified in the sediment sample analytical results, the pipe section removed from trench segment 12-C34-00-8B was placed in LLRW bin GFLU001119X1 on November 11, 2013 since the pipe was too narrow in diameter to properly survey. The brick materials forming manhole MH988 were placed in LLRW bin BFLU000353X1 on November 8, 2013 due to elevated survey results. The sediment sample laboratory analytical reports are provided in Appendix I.

The analytical results for the sediment sample collected from manhole MH989 (sample 12-PCMH989-011-01) identified the presence of Ra-226 contamination at 1.854 pCi/g (Table 3-5). The analytical results for the sediment sample collected from the pipe section removed from trench segment 12-C34-28-8L (sample 12-PCPI-0017-01) identified the presence of Cs-137 contamination at 0.3763 pCi/g. Based on these results, the brick materials forming manhole MH989 were placed in LLRW bin GFLU001235T17 on September 4, 2013 and the pipe section from trench segment 12-C34-28-8L was placed in LLRW bin GFLU001119X1 on November 11, 2013 for off-site disposal by the DON radiological waste contractor.

Radiological survey activities were performed for manholes MH985, MH988, and MH1350; three sections of pipe removed from trench segment 12-28-28-8A; one section of pipe removed from 12-253-28-5G; one section of pipe removed from 12-253-28-5I; two sections of pipe removed

from 12-253-28-5O; two sections of pipe removed from 12-253-28-8B; two sections of pipe removed from 12-253-28-8C; one section of pipe removed from 12-C34-28-4K; and one section of pipe removed from 12-C34-28-4P (Table 3-6). No elevated survey results were identified for manholes MH985 or MH1350 (survey HPS-PCPIPE-101413-100) or the majority of the pipe sections removed from TU336 (surveys HPS-PCPIPE-051214-118, HPS-PCPIPE-100913-097, HPS-PCPIPE-101013-098, and HPS-PCPIPE-101413-100). The survey results for the pipe sections removed from trench segments 12-253-28-5I, 12-C34-28-4K, and 12-C34-28-4P identified net beta/gamma static measurements above the release limit ranging from 1,148 dpm/100 cm² (survey HPS-PCPIPE-100913-097) to 3,002 dpm/100 cm² (survey HPS-PCPIPE-071913-081). Consequently, the pipe sections removed from trench segments 12-253-28-5I, 12-C34-28-4K, and 12-C34-28-4P were placed in LLRW bins GFLU001119X1 and GFLU001031T17 for off-site disposal by the DON radiological waste contractor. Copies of the radiological survey reports are presented in Appendix J.

Survey activities were performed for a pipe trench segment 12-253-28-8L section exiting radiologically impacted Building 253 on October 10, 2013 (survey HPS-PCPIPE-101013-099). Survey results for the pipe section entering Building 253 identified an elevated net beta/gamma static measurement above the release limit at 1,460 dpm/100 cm². Since the DON did not include the pipe entering Building 253 in the Parcel C Phase II removal action, the elevated pipe was capped to eliminate the possibility of contamination from Building 253 entering TU336.

Initially, five investigative soil samples were collected from TU336 and submitted to the laboratory for analysis on September 20, 2013 due to the Ra-226 and Cs-137 sediment contamination identified in manhole MH989 and the pipe section removed from trench segment 12-C34-28-8L. No ROC concentrations above the release criteria were identified in the investigative soil samples. An additional 12 investigative soil samples were collected from TU336 on December 17, 2013 and submitted to the laboratory for analysis. The screening analytical results for one soil sample identified the presence of Ra-226 activity at 2.133 pCi/g; however, following definitive analysis, the Ra-226 concentration was less than the release limit.

6.6.2 TU336 Piping Remaining in Place

No known storm drain or sanitary sewer systems piping associated with TU336 remained in place within Parcel C following completion of the Phase II time-critical removal action activities.

6.6.3 TU336 Final Status Survey Summary

A total of 18 systematic soil samples were collected from the exposed sidewalls and bottom of TU336 and submitted to the laboratory for definitive analysis on January 28, 2014 during the Parcel C Phase II project area removal action. No ROC concentrations above the release criteria specified in the AM (DON 2006) or the remediation goals established in the ROD (DON 2010) were identified in the TU336 FSS soil sample analytical results. The release criteria are identified

in Tables 2-1 and 2-3, and the remediation goals are presented in Table 2-2. Figure 6-1 depicts the FSS soil sample collection locations in TU336. The range in the gamma scan survey and static survey count rates, and the FSS laboratory analytical reports were presented in Attachments 1 and 3, respectively, to the TU336 SUPR provided in Appendix E.

For the FSS, TU336 was defined as the sum of the trench unit and the backfill materials composed of both a radiologically processed and released excavated soil survey unit and a volume of imported fill. The average net residual ROC concentrations for materials used as backfill in TU336 were 0.020 pCi/g for Cs-137, 0.154 pCi/g for Sr-90, and -0.113 pCi/g for Ra-226. The trench unit average net residual ROC concentrations were 0.021 pCi/g for Cs-137, 0.098 pCi/g for Sr-90, and 0.015 pCi/g for Ra-226. The net Ra-226 concentration (with background Ra-226 subtracted) was used to calculate dose and risk. No background was subtracted from the Cs-137 or Sr-90 values since these radionuclides were not naturally occurring or expected due to nuclear weapons testing fallout at pipe depths.

RESRAD modeling using the larger of the MDL or the net residual ROC and their decay product concentrations resulted in a dose of 0.527 mrem/y with an increased cancer risk of 6.804×10^{-6} for the backfill material and 0.5726 mrem/y with an increased cancer risk of 8.227×10^{-6} for the trench unit (Yu et. al. 2001). These results were less than the NRC criterion of 25 mrem/y and the increased cancer risk falls within the EPA risk management range of 10^{-6} to 10^{-4} . The modeling parameters, values, and results were presented in Attachments 7 and 8 to the TU336 SUPR (Appendix E).

The results of the modeling efforts determined that the potential TU336 dose due to net residual ROC and their decay product concentrations greater than or equal to the MDL was 0.5726 mrem/y with an increased cancer risk of 8.227×10^{-6} , which supports radiological free release. Qualitative ALARA analyses resulted in: 1) no FSS gamma survey measurements above the investigation levels, 2) none of the FSS sample results identified net residual ROC and their decay product concentrations above the ROC release criteria, 3) no air monitoring results exceeded 10 percent of the derived air concentration for members of the public, and 4) no personnel dosimetry badges processed identified doses above background levels. No further radiological action was recommended in the TU336 SUPR (Appendix E). Table 3-1 summarizes the activities performed during the Parcel C Phase II project area removal action to support the recommended radiological free release of TU336.

6.6.4 TU336 Backfill Activities

Radiologically processed and released excavated soil survey unit ES-799 and a volume of imported fill were selected as the backfill materials for TU336. Radiological information related to the processing of ES-799 is summarized in Table 3-4 and the associated laboratory analytical results

were discussed in the TU336 SUPR (Appendix E). The radiological and chemical analytical reports for the imported fill are provided in Appendix K.

The DON concurred with backfilling TU336 on March 17, 2014 (Table 3-1). Backfill operations commenced on March 20, 2014 and were completed on March 24, 2014. An estimated 702 cubic yards of soil was placed in TU336 to grade followed by the application of road base material over the backfilled trench. Backfill activities were performed in accordance with the HPNS Basewide Construction Specifications (TtEC 2012e). Parcel C Phase II project area restoration activities are described in Section 9.0.

6.7 TRENCH SURVEY UNIT 337

TU337 is located in the southwestern portion of Work Area 34, adjacent to the west side of radiologically impacted Building 253 and extends along Nimitz Avenue (Figures 3-1 and 6-1). TU337 connects to TU327 on the north and west, and TU338 on the south. On the east, TU337 parallels Building 253. TU337 is situated within IR Program Site IR-28. The chemicals of concern associated with IR-28 are listed in Table 3-9.

TU337 is composed of nine storm drain trench segments and five sanitary sewer trench segments. As identified on Figure 6-1 and Table 3-1, these trench segments include:

<u>Storm Drain Trench Segments</u>	<u>Sanitary Sewer Trench Segments</u>
<ul style="list-style-type: none">• 12-253-28-3J• 12-253-28-3K• 12-253-28-8D• 12-C33-28-3F• 12-C34-28-3H• 12-C34-28-3J• 12-C34-28-3Q• 12-C34-28-5L• 12-C34-28-8K	<ul style="list-style-type: none">• 12-253-28-3I• 12-C33-28-8F• 12-C34-28-3I• 12-C34-28-5J• 12-C34-28-5M

Storm drain trench segments 12-253-28-3J and 12-C33-28-3F and sanitary sewer trench segment 12-253-28-3I continue into TU327 on the north. Storm drain trench segment 12-C34-28-3Q and sanitary sewer trench segment 12-C34-28-5M transition into TU338 on the south. With the exception of 12-253-28-8D, 12-C33-28-8F, and 12-C34-28-8K, each of the trench segments associated with TU337 was identified in the Design Plan (TtEC 2012d). Trench segment 12-253-28-8D was found during excavation of manhole MH1348 and trench segment 12-253-28-3J. Trench segments 12-C33-28-8F and 12-C34-28-8K were found during excavation of TU327 and

manhole MH972. Although identified in the Design Plan (TtEC 2012d), 18 feet of storm drain trench segment 12-253-28-3K could not be found after several excavation attempts.

6.7.1 TU337 Removal Action Activities

Excavation activities for TU337 began on August 13, 2013 in trench segment 12-253-28-3J. A total of 82 truckloads of soil (approximately 984 cubic yards) were excavated from TU337 during the Parcel C Phase II project area removal action (Table 3-3). Soil generated during excavation of TU337 was transferred to RSY4 for radiological processing (Table 3-4). Following completion of the excavation on August 20, 2013, TU337 exhibited an exposed surface area of 863 m² and was 404 linear feet in length (Table 3-1). The maximum excavated TU337 depths ranged between 7 feet and 10 feet bgs (Table 3-2).

Manholes MH972, MH975, MH978, and MH1348 and 20 sections of pipe were removed from TU337 during the Parcel C Phase II project area removal action and placed on plastic pending further activities (Figure 6-1). The majority of the TU337 piping disintegrated upon removal and the debris was transferred along with the surrounding excavated soil to RSY4 for radiological processing. As indicated in Table 3-2, sanitary sewer trench segments 12-253-28-3I, 12-C34-28-3I, -5J, and -5M contained 10-inch-diameter VCP located at depths between 7 feet and 9 feet bgs. Sanitary sewer trench segment 12-C33-28-8F contained 8-inch-diameter VCP located at a depth of approximately 6 feet bgs. Storm drain trench segments 12-253-28-3J, 12-C34-28-3J, and -3Q contained 27-inch-diameter VCP located at depths between 5 feet and 8 feet bgs. The remainder of the storm drain trench segments contained 4-inch-diameter to 12-inch-diameter VCP located at depths between 6 feet and 9 feet bgs.

A sufficient volume of sediment for sample collection and analysis was found in manhole MH978 (sample 12-PCMH978-013-01) and a section of pipe at the terminus of trench segment 12-253-28-8D and flush with the Building 253 foundation (sample 12-PCPI-0019-01) during the Parcel C Phase II removal action activities (Table 3-5). The analytical results for the sediment samples collected from manhole MH978 and the trench segment 12-253-28-8D pipe exiting Building 253 identified the presence of Cs-137 contamination at 1.999 pCi/g and Ra-226 contamination at 5.940 pCi/g, respectively. Manhole MH978 was placed in LLRW bin GFLU001209T18 for off-site disposal by the DON radiological waste contractor. The pipe exiting Building 253 was capped to eliminate the possibility of contamination from Building 253 entering TU337.

Radiological survey activities were performed for Manholes MH972 (survey HPS-PCPIPE-101613-104), MH975 (survey HPS-PCPIPE-101613-104), and MH1348 (survey HPS-PCPIPE-101513-102), 12 sections of pipe removed from trench segment 12-253-28-3J (survey HPS-PCPIPE-102313-108), 1 section of pipe removed from trench segment 12-C33-28-3F (survey HPS-PCPIPE-101613-105), and 4 sections of pipe removed from trench segment 12-C34-28-3J (survey HPS-PCPIPE-101513-103) during the Parcel C Phase II project area removal action (Table

3-6). No results above the release limits were identified for manholes MH972, MH975, the pipe removed from trench segment 12-C33-28-3F, or the four pipe sections removed from trench segment 12-C34-28-3J. Based on these results, the two manholes and five pipe sections were released and transferred to the DON non-LLRW contractor for off-site disposal or recycling. The survey results for manhole MH1348 identified a net/beta gamma static measurement above the release limit at 1,183 dpm/100 cm². Based on this result, the brick materials forming manhole MH1348 were placed in LLRW bin BFLU000353X1 on November 8, 2013 for off-site disposal by the DON radiological waste contractor.

The survey results for the 11 of the 12 sections of pipe removed from trench segment 12-253-28-3J did not identify elevated measurements. However, one section of pipe identified the presence of a net beta/gamma measurement of 1,030 dpm/100 cm². Based on this result, each of the pipe sections associated with trench segment 12-253-28-3J were placed in LLRW bin BFLU000353X1 on November 8, 2013 for off-site disposal by the DON radiological waste contractor.

No survey activities were performed for one pipe section from trench segment 12-253-28-3J and one section from 12-C34-28-3J during the Parcel C Phase II removal action activities (Table 3-6). To facilitate completion of fieldwork, both sections of pipe were placed in LLRW bin GFLU001023T19 on September 4, 2013 for off-site disposal by the DON radiological waste contractor.

A total of 17 investigative soil samples were collected from the bottom of TU337 on October 18, 2013 due to presence of Cs-137 contamination in the sediment sample collected from manhole MH978 and the Ra-226 contamination identified in the sediment sample collected from a trench segment 12-253-28-8D pipe section. No ROC concentrations above the release criteria were identified in the investigative soil sample analytical results.

6.7.2 TU337 Piping Remaining in Place

No known storm drain or sanitary sewer systems piping associated with TU337 remained in place within Parcel C following completion of the Phase II time-critical removal action activities.

6.7.3 TU337 Final Status Survey Summary

Eighteen systematic soil samples were collected from the exposed sidewalls and bottom of TU337 and submitted to the laboratory for analysis on November 14, 2014 during the Parcel C Phase II project area removal action. No ROC concentrations above the release criteria specified in the AM (DON 2006) or the remediation goals established in the ROD (DON 2010) were identified in the TU337 FSS soil sample analytical results. The release criteria are identified in Tables 2-1 and 2-3, and the remediation goals are presented in Table 2-2. Figure 6-1 depicts the FSS soil sample collection locations in TU337. The range of the gamma scan survey and static survey count rates,

and the FSS laboratory analytical reports were presented in Attachments 1 and 3, respectively, to the TU337 SUPR provided in Appendix E.

TU337 was defined for the FSS as the sum of the trench unit and the backfill materials composed of imported fill. The average net residual ROC concentrations for materials used as backfill in TU337 were 0.020 pCi/g for Cs-137, 0.148 pCi/g for Sr-90, and -0.136 pCi/g for Ra-226. The trench unit average net residual ROC concentrations were 0.020 pCi/g for Cs-137, 0.144 pCi/g for Sr-90, and 0.066 pCi/g for Ra-226. The net Ra-226 concentration (with background Ra-226 subtracted) was used to calculate the dose and risk. No background was subtracted from the Cs-137 or Sr-90 values since these radionuclides were not naturally occurring or expected due to nuclear weapons testing fallout at pipe depths.

RESRAD modeling using the larger of the MDL or reported net residual ROC and their decay product concentrations resulted in a dose of 0.5568 mrem/y with an increased cancer risk of 7.182×10^{-6} for the backfill material and 1.577 mrem/y with an increased cancer risk of 2.379×10^{-5} for the trench unit (Yu et. al. 2001). These results were less than the NRC criterion of 25 mrem/y and the increased cancer risk falls within the EPA risk management range of 10^{-6} to 10^{-4} . The modeling parameters, values, and results were presented in Attachments 4 and 5 to the TU337 SUPR (Appendix E).

The results of the modeling efforts determined that the potential TU337 dose due to net residual ROC and their decay product concentrations greater than or equal to the MDL was 1.577 mrem/y with an increased cancer risk of 2.379×10^{-5} , which supports radiological free release. Qualitative ALARA analyses resulted in: 1) no FSS gamma survey measurements above the investigation levels, 2) none of the FSS sample results identified net residual ROC concentrations above the release criteria, 3) no air monitoring results exceeded 10 percent of the derived air concentration for members of the public, and 4) no personnel dosimetry badges processed identified doses above background levels. No further radiological action was recommended in the TU337 SUPR (Appendix E). Table 3-1 summarizes the activities performed during the Parcel C Phase II project area removal action to support the recommended radiological free release of TU337.

6.7.4 TU337 Backfill Activities

A volume of imported fill was selected as the appropriate backfill material for TU337. The radiological and chemical analytical reports for the imported fill are provided in Appendix K.

The DON concurred with backfilling TU337 on January 14, 2014 (Table 3-1). Backfill operations commenced on February 4, 2014 and were completed on February 11, 2014. An estimated 1,246 cubic yards of soil was placed in TU337 to grade followed by the application of road base material over the backfilled trench. Backfill activities were performed in accordance with the HPNS

Basewide Construction Specifications (TtEC 2012e). Parcel C Phase II project area restoration activities are described in Section 9.0.

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7.0 WORK AREA 35

Work Area 35 is located on the north side of Parcel C (Figure 1-3). It is bounded by Parcel B on the north and east, Work Areas 33 and 34 on the south, and Parcel UC2 on the west. The radiological activities performed for Work Area 35 were limited to TU312, TU313, TU314, TU333, TU334, and TU335 (Figures 3-1 and 7-1). No further storm drain or sanitary sewer systems piping were excavated from Work Area 35 during the first or second phases of the Parcel C time-critical removal action. The following sections summarize the radiological work activities completed in Work Area 35 during the Parcel C Phase II project area removal action.

7.1 TRENCH SURVEY UNIT 312

TU312 is located in the northwest corner of Work Area 35 within Parcel C along Lockwood Street (Figures 3-1 and 7-1). On the north, east, and west, TU312 connects to trench survey units associated with Parcel B. On the south, TU312 connects to TU313. The majority of trench segments associated with TU312 are situated within IR Program Sites IR-6 and IR-24. The chemicals of concern associated with these IR Program Sites are listed in Table 3-9.

TU312 is composed of seven sanitary sewer trench segments and no storm drain trench segments. As identified on Figure 7-1 and Table 3-1, these trench segments include:

- 12-C35-00-2C
- 12-C35-00-2U
- 12-C35-06-1N
- 12-C35-06-2A
- 12-C35-06-2B
- 12-C35-06-2C
- 12-C35-24-1N

Trench segment 12-C35-06-2B transitioned into TU313 on the south. Each of the trench segments associated with TU312 was identified in the Design Plan (TtEC 2012d). Although identified in the Design Plan, Manhole MH-37 and trench segments 12-C25-00-2A and -3A, 12-C35-10-2A, -2B, and -3A, and 12-C35-24-2B and -3A could not be found after several excavation attempts. Manhole MH-37 and these pipe segments likely were removed during previous DON storm drain and sanitary sewer activities.

7.1.1 TU312 Removal Action Activities

Excavation activities for TU312 were initiated on November 19, 2012 in trench segments 12-C35-00-2U and -3A. A total of 123 truckloads of soil (approximately 1,476 cubic yards) were excavated from TU312 during the Parcel C Phase II project area removal action (Table 3-3). Soil generated during excavation of TU312 was transferred to RSY4 for radiological processing (Table 3-4). Following completion of the excavation on December 7, 2012, TU312 had an exposed

surface area of 950 m² and was 765 linear feet in length (Table 3-1). The maximum excavated TU312 depths ranged between 4 feet and 10 feet bgs (Table 3-2).

Manhole MH1342 and seven sections of pipe were removed from TU312 and placed on plastic pending further activities during the Parcel C Phase II project area removal action (Figure 7-1). The majority of the TU312 piping crumbled during removal and the debris was transferred along with the surrounding excavated soil to RSY4 for radiological processing. As indicated in Table 3-2, sanitary sewer trench segments 12-C35-00-2C and 12-C35-06-2A contained 8-inch-diameter VCP located at depths between 3 feet and 8 feet bgs. Trench segments 12-C35-00-2U and 12-C35-06-2C contained 18-inch-diameter RCP located at depths ranging from 7 feet to 8 feet bgs. Trench segments 12-C35-06-1N and 12-C35-24-1N contained 18-inch-diameter RCP located at depths between 5 feet and 7 feet bgs. Trench segment 12-C35-06-2B contained 21-inch-diameter RCP located at depths ranging from 8 feet to 10 feet bgs.

A sufficient volume of sediment was available for sample collection and analysis in two sections of pipe removed from trench segment 12-C35-00-2U (samples 12-PCPI-0001-01 and 12-PCPI-0002-01), one section of pipe removed from trench segment 12-C35-06-2B (sample 12-PCPI-0003-01), and Manhole MH1342 (sample 12-PCMH1342-001-01) during the Parcel C Phase II project area removal action (Table 3-5). In addition, the sediment samples collected from the two sections of pipe removed from trench segment 12-C35-00-2U were submitted to the off-site laboratory for total strontium analysis. No ROC concentrations above the release criteria were identified in the sediment sample collected from Manhole MH1342. The sediment samples collected from the two sections of pipe removed from trench segment 12-C35-00-2U identified the presence of Cs-137 contamination with 0.1928 pCi/g and 0.2364 pCi/g and the sediment sample collected from trench segment 12-C35-06-2B identified the presence of Cs-137 contamination with 0.3235 pCi/g. The pipe sections associated with the Cs-137 contaminated sediments were placed in LLRW bins GFLU002048T2 and GFLU002138T2 in December 2012 pending off-site disposal by the DON radiological waste contractor. In addition one section of trench segment 12-C35-00-2U pipe that did not contain a sufficient volume of sediment for sample collection and analysis was placed in LLRW GFLU001048T2 on December 7, 2012 since it was connected to the pipe section containing the Cs-137 contaminated sediment samples. The sediment sample laboratory analytical reports are provided in Appendix I.

Radiological survey activities were performed for Manhole MH1342 and three sections of pipe removed from trench segment 12-C35-24-1N during the Parcel C Phase II project area removal action (Table 3-6). No elevated results were identified for Manhole MH1342 or the three sections of pipe surveyed. Based on these results, the brick and concrete material forming the manhole was released and the debris transferred to the DON non-LLRW contractor for off-site disposal or recycling. Although no survey was performed, a pipe section from trench segment 12-C35-00-2U was placed in LLRW Bin GFLU002048T2 on December 7, 2012 since this pipe was removed

from the same area as the two pipe sections containing sediments with elevated Cs-137. Table 3-6 identifies the associated radiological survey report number and final disposition of Manhole MH1342, the three pipe sections removed from trench segment 12-C35-24-1N, and the pipe section removed from trench segment 12-C35-00-2U. Copies of the radiological survey reports are presented in Appendix J.

A total of 26 investigative soil samples were collected from the exposed bottom of TU312 on February 14, 2014 and submitted to the laboratory for gamma spectroscopy analysis due to the presence of Cs-137 contamination in the sediment samples collected from pipe sections removed from trench segments 12-C35-00-2U and 12-C35-06-2B (Tables 3-1 and 3-5). The laboratory analytical results did not identify the presence of radiological contamination in the 26 investigative soil samples analyzed. The laboratory analytical results are included in the TU312 SUPR provided in Appendix F.

7.1.2 TU312 Piping Remaining in Place

No known storm drain or sanitary sewer systems piping associated with TU312 remained in place within Parcel C following completion of the Phase II time-critical removal action activities.

7.1.3 TU312 Final Status Survey Summary

A total of 18 systematic FSS soil samples were collected from the exposed sidewalls and bottom of TU312 and submitted to the laboratory for analysis on March 7, 2013 during the Parcel C Phase II project area removal action. No ROC concentrations above the release criteria specified in the AM (DON 2006) or the remediation goals established in the ROD (DON 2010) were identified in the TU312 FSS soil sample analytical results. The release criteria are identified in Tables 2-1 and 2-3, and the remediation goals are presented in Table 2-2. Figure 7-1 depicts the FSS soil sample collection locations in TU312. The range in the gamma scan survey and static survey count rates, and the FSS laboratory analytical reports were presented in Attachments 1 and 3, respectively, to the TU312 SUPR provided in Appendix F.

TU312 was defined for the FSS as the sum of the trench unit and the backfill materials composed of both radiologically processed and released excavated soil survey units and a volume of imported fill. The average net residual ROC concentrations for materials used as backfill in TU312 were 0.021 pCi/g for Cs-137, 0.154 pCi/g for Sr-90, and -0.082 pCi/g for Ra-226. The trench unit average net residual ROC concentrations were 0.023 pCi/g for Cs-137, 0.158 pCi/g for Sr-90, and 0.178 pCi/g for Ra-226. The net Ra-226 concentration (with background Ra-226 subtracted) was used to calculate dose and risk. No background was subtracted from the Cs-137 or Sr-90 values since these radionuclides were not naturally occurring or expected due to nuclear weapons testing fallout at pipe depths.

RESRAD modeling using the larger of the MDL or reported net residual ROC and their decay product concentrations resulted in a dose of 0.6343 mrem/y with an increased cancer risk of 8.170×10^{-6} for the backfill material and 3.621 mrem/y with an increased cancer risk of 5.598×10^{-5} for the trench unit (Yu et. al. 2001). These results were less than the NRC criterion of 25 mrem/y and the increased cancer risk falls within the EPA risk management range of 10^{-6} to 10^{-4} . The modeling parameters, values, and results were presented in Attachments 7 and 8 to the TU312 SUPR (Appendix F).

The results of the modeling efforts determined that the potential TU312 dose due to net residual ROC and decay product concentrations greater than or equal to the MDL was 3.621 mrem/y with an increased cancer risk of 5.598×10^{-5} , which supports radiological free release. Qualitative ALARA analyses resulted in: 1) no FSS gamma survey measurements above the investigation levels, 2) none of the FSS sample results identified net residual ROC concentrations above the release criteria, 3) no air monitoring results exceeded 10 percent of the derived air concentration for members of the public, and 4) no personnel dosimetry badges processed identified doses above background levels. No further radiological action was recommended in the TU312 SUPR (Appendix F). Table 3-1 summarizes the activities performed during the Parcel C Phase II project area removal action to support the recommended radiological free release of TU312.

7.1.4 TU312 Backfill Activities

Radiologically processed and released excavated soil survey units and a volume of imported fill were selected as the backfill materials for TU312. The excavated soil survey units selected as backfill material included:

- ES-749
- ES-752

Radiological information related to the processing of these excavated soil survey units is summarized in Table 3-4 and the associated laboratory analytical results are discussed in the TU312 SUPR (Appendix J). The radiological and chemical analytical reports for the imported fill are provided in Appendix K.

The ~~RASO-DON~~ concurred with backfilling TU312 on May 23, 2013 (Table 3-1). Backfill operations commenced on June 4, 2013 and were completed on June 7, 2013. An estimated 1,260 cubic yards of soil was placed in TU312 to grade followed by the application of road base material over the backfilled trench. Backfill activities were performed in accordance with the HPNS Basewide Construction Specifications (TtEC 2012e). Parcel C Phase II project area restoration activities are described in Section 9.0.

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7.2 TRENCH SURVEY UNIT 313

TU313 is located in the northwest corner of Work Area 35 within Parcel C along Lockwood Street (Figures 3-1 and 7-1). TU313 connects to TU312 on the north and TU314 on the south. On the west, TU313 terminates prior to Manhole MH-28 and the active City of San Francisco pipelines. On the east, TU313 terminates within the 10-foot buffer zone surrounding non-radiologically impacted Building 134. The majority of trench segments associated with TU313 are situated within IR Program Sites IR-6 and IR-25. The chemicals of concern associated with these IR Program Sites are listed in Table 3-9.

TU313 is composed of nine storm drain trench segments and two sanitary sewer trench segments. As identified on Figure 7-1 and Table 3-1, these trench segments include:

<u>Storm Drain Trench Segments</u>	<u>Sanitary Sewer Trench Segments</u>
<ul style="list-style-type: none">• 12-C35-00-4A• 12-C35-06-3E• 12-C35-06-3F• 12-C35-06-4A• 12-C35-06-4B• 12-C35-25-4A• 12-C35-25-4B• 12-C35-25-4D• 12-C35-25-4E	<ul style="list-style-type: none">• 12-C35-00-2T• 12-C35-06-2B

Sanitary sewer trench segment 12-C35-00-2T and storm drain trench segment 12-C35-00-4A continue into TU314 on the south. Sanitary sewer trench segment 12-C35-06-2B extends into TU312 on the north. Each of the trench segments associated with TU313 was identified in the Design Plan (TtEC 2012d). Although identified in the Design Plan, trench segments 12-C35-06-3C, -3D, and -3G, as well as manholes MH24, MH26, and MH27, could not be found after several excavation attempts and were likely removed during previous DON activities.

7.2.1 TU313 Removal Action Activities

Excavation activities for TU313 commenced on November 20, 2012 in storm drain trench segment 12-C35-06-3F. A total of 148 truckloads of soil (approximately 1,176 cubic yards) were excavated from TU313 during the Parcel C Phase II project area removal action (Table 3-3). Soil generated during excavation of TU313 was transferred to RSY4 for radiological processing (Table 3-4). Following completion of the excavation on January 3, 2013, TU313 had an exposed surface area

of 781 m² and was 296 linear feet in length (Table 3-1). The maximum excavated TU313 depths ranged between 7 feet and 10 feet bgs (Table 3-2).

Manholes MH29, MH30, and MH31 and 32 sections of pipe were removed from TU313 during the Parcel C Phase II project area removal action and placed on plastic pending further activities (Figure 7-1). The TU313 piping that disintegrated during removal was transferred along with the surrounding excavated soil to RSY4 for radiological processing. As indicated in Table 3-2, sanitary sewer trench segments 12-C35-00-2T and 12-C35-06-2B contained 21-inch-diameter RCP located at depths ranging from 5 feet to 8 feet bgs. The remaining storm drain trench segments associated with TU313 contained 10-inch-diameter to 30-inch-diameter VCP located at depths between 5 feet and 8 feet bgs.

A sufficient volume of sediment was available for sample collection and analysis in manholes MH29 (sample 12-PCMH029-002-01) and MH30 (sample 12-PCMH030-003-01) and two sections of pipe removed from trench segment 12-C35-06-3F (samples 12-PCPI-0004-01 and 12-PCPI-0005-01) during the Parcel C Phase II project area removal action (Table 3-5). No radioactivity concentrations above the release criteria were identified by the laboratory analytical results for MH29 or MH30 or the two sections of pipe removed from trench segment 12-C35-06-3F. Although no elevated ROC concentrations were identified in the sediment sample analytical results for the two sections of pipe removed from trench segment 12-C35-06-2B, both sections were placed in LLRW bins GFLU002138T2 and GFLU001209T17 due to the presence of Cs-137 contamination at 0.3235 pCi/g in the sediment sample collected from adjacent trench segment 12-C35-06-2B pipe removed from TU312. The sediment sample laboratory analytical reports are provided in Appendix I.

Radiological survey activities were performed for manholes MH29, MH30, and MH31. In addition, survey activities were performed for 3 sections of pipe removed from trench segment 12-C35-06-3E, 24 sections of pipe removed from trench segment 12-C35-06-3F, 1 section of pipe removed from trench segment 12-C35-06-4B, 2 sections of pipe removed from trench segment 12-C35-25-4B, and 2 sections of pipe removed from trench segment 12-C35-25-4D during the Parcel C Phase II project area removal action (Table 3-6). With the exception of the manholes MH30 and MH31, no elevated results were identified for the pipe sections removed from TU313 or manhole MH29. Based on these results, the sections of TU313 pipe and the materials forming MH29 were released and the debris transferred to the DON non-LLRW contractor for off-site disposal or recycling. The survey results for MH30 (survey HPS-PCPIPE-010813-059) identified net beta/gamma static measurements above the release limit at 1,128 dpm/100 cm² and 1,145 dpm/100 cm². The survey results for MH31 identified a net beta/gamma static measurement above the release limit at 1,388 dpm/100 cm². Consequently, the brick and concrete materials forming manholes MH30 and MH31 were placed in LLRW bin GFLU002035 on January 22, 2013 for off-

site disposal by the DON radiological waste contractor. Copies of the radiological survey reports are presented in Appendix J.

Initially, a total of 13 investigative soil samples were collected from the exposed bottom of TU313 on March 7, 2013 and submitted to the laboratory for analysis due to the adjacent TU312 sediment sample with identified Cs-137 contamination (Tables 3-1 and 3-5). No ROC concentrations exceeding the release criteria were identified in the investigative soil sample analytical results. Based on these results, a total of 18 systematic soil samples were collected from the exposed bottom and sidewalls of TU313 and submitted to the laboratory for analysis by gamma spectroscopy. The analytical results identified the presence of Ra-226 in one soil sample with 1.713 pCi/g, which exceeded the SUPR Abstract release criterion, but was less than the NORM Abstract (Appendix A) release criterion. Regardless, approximately 1.5 cubic yards of soil was removed from trench segment 12-C35-25-4A on March 29, 2013 (Table 3-8). The remediated soil was placed in LLRW bin GFLU002088T1 for off-site disposal by the DON radiological waste contractor. Following the remediation effort, a total of three verification soil samples were collected on March 29, 2013 and submitted to the laboratory for analysis. The analytical results identified the presence of Ra-226 (1.922 pCi/g) in one soil sample. The laboratory analytical results were provided in Attachment 2 to the TU313 SUPR provided in Appendix F.

Due to the presence of Ra-226 in one soil sample collected from TU313, approximately 4.5 cubic yards of soil was removed from trench segment 12-C35-25-4A on April 11, 2013 followed by the collection of three verification soil samples. The remediated soil was placed in LLRW bin GFLU001206T19 for off-site disposal by the DON radiological waste contractor (Table 3-8). The verification sample analytical results identified the presence of Ra-226 above the SUPR Abstract release criterion in two verification soil samples at 1.550 pCi/g and 1.560 pCi/g, but less than the NORM Abstract release limit (Table 2-4). Based on these results, an estimated 3.5 cubic yards of soil was removed from trench segment 12-C35-25-4A and placed in LLRW bins for off-site disposal by the DON radiological waste contractor. Following the remediation efforts, a total of three verification soil samples were collected and analyzed. The analytical results for one of the verification soil samples identified the presence of Ra-226 above the NORM Abstract release criterion at 2.096 pCi/g.

Approximately 24 cubic yards of soil was removed from trench segment 12-C35-25-4A on May 15, 2013 based on the presence of Ra-226 contamination. The remediated soil was placed in LLRW bins GFLU002138T3, GFLU001183T19, and GFLU001185T19 for off-site disposal by the DON radiological waste contractor (Table 3-8). Following the remediation efforts, three verification soil samples were collected and analyzed. The analytical results identified Ra-226 activity above the SUPR Abstract release criterion in one soil sample at 1.647 pCi/g; however, this result was less than the NORM Abstract Ra-226 release criterion. Consequently, the DON

concluded that the persistence of relatively elevated Ra-226 radioactivity above the SUPR Abstract release criteria was likely due to the presence of NORM fill material as described in Section 2.5.8.

In total, approximately 33.5 cubic yards of soil was removed from TU313 during the Parcel C Phase II project area removal action and 25 soil samples (including investigative and verification samples) were collected and analyzed in addition to the 18 systematic FSS soil samples (Table 3-1). Figure 7-2 depicts the approximate locations of the Ra-226 soil samples in TU313 associated with the NORM fill materials.

7.2.2 TU313 Piping Remaining in Place

A total of 10 linear feet of storm drain trench segment 12-C35-25-4D 30-inch-diameter VCP was excavated prior to being terminated near Building 134 during the Parcel C Phase II project area removal action activities. Based on field observations, an estimated 10 linear feet of trench segment 12-C35-25-4D remained in place within the 10-foot buffer zone surrounding Building 134 to preserve the integrity of the structure (Table 3-7). To ensure that no residual radioactivity above the release criteria was associated with the 10 linear feet of pipe remaining in place, radiological survey activities were performed on February 21, 2013 at the end of the pipe section remaining in place (survey HPS-PCPIPE-012113-060). No elevated survey results were identified for the trench segment 12-C35-25-4D piping. Based on these results, the DON concluded that the 10 linear feet of pipe remaining in place was unlikely to be contaminated. A copy of the survey report is provided in Appendix J.

At the request of the City of San Francisco, manhole MH28 was not removed during the Parcel C Phase II project area removal action activities to facilitate drainage of Robinson Street. A radiological survey was performed for MH28 on February 27, 2013 (survey HPS-PCPIPE-022713-069) to ensure that no residual surface concentrations above the release criteria was present. Based on these results, the DON concluded that MH28 was unlikely to be contaminated. A copy of the survey report is provided in Appendix J.

7.2.3 TU313 Final Status Survey Summary

The original 18 systematic soil samples collected from the exposed sidewalls and bottom of TU313 on March 21, 2013 were submitted to the laboratory for definitive analysis during the Parcel C Phase II project area removal action. No ROC concentrations above the release criteria specified in the NORM Abstract (Appendix A) were identified in the TU313 FSS soil sample analytical results. The NORM Abstract release criteria are specified in Table 2-4. Figure 7-1 depicts the FSS soil sample collection locations in TU313. The range in the gamma scan survey and static survey count rates were presented in Attachment 1 to the TU313 SUPR provided in Appendix F. The laboratory analytical reports for the FSS soil samples were included in Attachment 3 to the TU313 SUPR.

For the FSS, TU313 was defined as the trench survey unit since no backfill was placed in the excavation during the Parcel C Phase II project area removal action. The trench unit average net residual ROC concentrations were 0.025 pCi/g for Cs-137, 0.213 pCi/g for Sr-90, and -0.370 pCi/g for Ra-226. The net Ra-226 concentration (with background Ra-226 subtracted) was used to calculate dose and risk. No background was subtracted from the Cs-137 or Sr-90 values since these radionuclides were not naturally occurring or expected due to nuclear weapons testing fallout at pipe depths.

RESRAD modeling using the larger of the MDL or the net ROC and decay product concentrations resulted in a dose of 0.7228 mrem/y with an increased cancer risk of 9.316×10^{-6} for the trench unit (Yu et. al. 2001). These results were less than the NRC criterion of 25 mrem/y with an increased cancer risk that falls within the EPA risk management range of 10^{-6} to 10^{-4} . The modeling parameters, values, and results were presented in Attachment 4 to the TU13 SUPR (Appendix F).

The results of the modeling efforts determined that the potential TU313 dose due to the net residual ROC and decay product concentrations greater than or equal to the MDL was 0.7228 mrem/y with an increased cancer risk of 9.316×10^{-6} , which supports radiological free release. Qualitative ALARA analyses resulted in: 1) no FSS gamma survey measurements above the investigation levels, 2) none of the FSS sample results identified net residual ROC concentrations above the release criteria specified in Table 2-4, 3) no air monitoring results exceeded 10 percent of the derived air concentration for members of the public, and 4) no personnel dosimetry badges processed identified doses above background levels. No further radiological action was recommended in the TU313 SUPR (Appendix F). Table 3-1 summarizes the activities performed during the Parcel C Phase II project area removal action to support the recommended radiological free release of TU313.

7.2.4 TU313 Backfill Activities

With the concurrence of the ~~RASO~~ DON on December 11, 2013, no backfill activities were performed by TtEC for TU313 during the Parcel C Phase II project area removal action. The TU313 area was subsequently transferred to the control of the DON's chemical remediation contractor since TU313 fell within the footprint of their scheduled remediation activities.

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7.3 TRENCH SURVEY UNIT 314

Physically separated into two distinct sections, TU314 is located in the northern section of Work Area 35 within Parcel C (Figures 3-1 and 7-1). The larger section of TU314 is located just north of Fisher Avenue along Lockwood Street and connects to TU313 on the north and Trench Survey Unit 136 (Parcel UC2) on the south. The smaller section of TU314 connects to trench survey units associated with Parcel B on the north (Trench Survey Unit 17), east (Trench Survey Unit 56), and south (Trench Survey Unit 18). On the west, the excavation of pipe was terminated within the 10-

foot buffer zone surrounding non-radiologically impacted Building 134. No IR Program Sites are associated with the larger section of TU314; however, the smaller section is situated within IR Program Site IR-25. The chemicals of concern associated with IR-25 are listed in Table 3-9.

TU314 consists of five storm drain trench segments and one sanitary sewer trench segment. As identified on Figure 7-1 and Table 3-1, these trench segments include:

<u>Storm Drain Trench Segments</u>	<u>Sanitary Sewer Trench Segments</u>
<ul style="list-style-type: none"> • 12-C35-00-4A • 12-C35-25-3O • 12-C35-25-3P • 12-C35-25-3Q • 12-C35-25-3Z 	<ul style="list-style-type: none"> • 12-C35-00-2T

Sanitary sewer trench segment 12-C35-00-2T and storm drain trench segment 12-C35-00-4A extended into TU313 on the north. Each of the trench segments associated with TU314 was identified in the Design Plan (TtEC 2012d).

7.3.1 TU314 Removal Action Activities

Excavation activities for TU314 commenced on December 18, 2012 in trench segment 12-C35-00-2T. A total of 79 truckloads of soil (approximately 948 cubic yards) were excavated from TU314 during the Parcel C Phase II project area removal action (Table 3-3). Soil generated during excavation of TU314 was transferred to RSY4 for radiological processing (Table 3-4). Following completion of the excavation on January 11, 2013, TU314 had an exposed surface area of 647 m² and was 232 linear feet in length (Table 3-1). The maximum excavated TU314 depths ranged between 7 feet and 13 feet bgs (Table 3-2).

Manhole MH51 and eight sections of pipe were removed from TU314 during the Parcel C Phase II project area removal action and placed on plastic pending further activities (Figure 7-1). The majority of the TU314 piping crumbled during removal and the debris was transferred along with the surrounding excavated soil to RSY4 for radiological processing. As indicated in Table 3-2, sanitary sewer trench segment 12-C35-00-2T contained 21-inch-diameter RCP located at depths between 7 feet and 11 feet bgs. Storm drain trench segments 12-C35-25-3O and -3P contained 30-inch-diameter VCP located at a depth of approximately 5 feet bgs. The remaining trench segments associated with TU314 contained 6-inch-diameter, 10-inch-diameter, and 12-inch-diameter VCP located at depths ranging from 6 feet to 11 feet bgs.

A sufficient volume of sediment was available for sample collection and analysis in sections of pipe removed from trench segments 12-C35-00-2T (sample 12-PCPI-0006-01) and 12-C35-25-3O

(sample 12-PCPI-0008-01) during the Parcel C Phase II project area removal action (Table 3-5). No radioactivity concentrations above the release criteria were identified in either of the two sediment samples analyzed. The sediment sample laboratory analytical reports are provided in Appendix I.

Radiological survey activities were performed for Manhole MH51, seven sections of pipe removed from trench segment 12-C35-00-2T, and one section of pipe removed from trench segment 12-C35-25-3O (Table 3-6). No elevated results were identified for Manhole MH51 or the eight sections of pipe surveyed. Based on these results, the brick materials forming the manhole and the eight sections of pipe were released and the debris transferred to the DON non-LLRW contractor for off-site disposal or recycling. Copies of the radiological survey reports are presented in Appendix J.

A total of 16 investigative soil samples were collected from the exposed bottom of TU314 on February 15, 2014 and submitted to the laboratory for gamma spectroscopy analysis due to the presence of Cs-137 contamination in sediment samples collected from pipe sections removed from contiguous TU313 (Tables 3-1 and 3-5). The laboratory analytical results for the 16 investigative soil samples collected from TU314 did not identify the presence of radiological contamination. The laboratory analytical results are included in the TU314 SUPR provided in Appendix F.

7.3.2 TU314 Piping Remaining in Place

A total of 9 linear feet of storm drain trench segment 12-C35-25-3O 30-inch-diameter VCP was excavated prior to being terminated 10 feet from non-radiologically impacted Building 134 during the Parcel C Phase II project area removal action activities. Based on field observations, an estimated 10 linear feet of trench segment 12-C35-25-3O pipe was left in place to protect the structural integrity of Building 134 (Table 3-7). To ensure that no residual radioactivity above the release criteria was associated with the 10 linear feet of pipe remaining in place, radiological survey activities were performed on January 21, 2013 (HPS-PCPIPE-012113-060). No elevated results were identified for the pipe remaining in place. Based on these results, the DON concluded that the 10 linear feet of pipe remaining in place was unlikely to be contaminated. A copy of the survey report is provided in Appendix J.

7.3.3 TU314 Final Status Survey Summary

A total of 18 systematic FSS soil samples and two biased soil samples were collected from the exposed sidewalls and bottom of TU314 on February 22, 2013 and submitted to the laboratory for analysis during the Parcel C Phase II project area removal action. The two biased soil samples were collected based on elevated gamma scan readings identified during the TU314 survey activities. No ROC concentrations above the release criteria specified in the AM (DON 2006) or the remediation goals established in the ROD (DON 2010) were identified in the TU314 FSS and biased soil sample analytical results. The release criteria are identified in Tables 2-1 and 2-3, and

the remediation goals are presented in Table 2-2. Figure 7-1 depicts the FSS soil sample collection locations in TU314. The range in the gamma scan surveys and static survey count rates and the FSS laboratory analytical reports were presented in Attachments 1 and 3, respectively, to the TU314 SUPR provided in Appendix F.

For the FSS, TU314 was defined as the sum of the trench unit and the backfill material composed of a volume of imported fill. The average net residual ROC concentrations for material used as backfill in TU314 were 0.020 pCi/g for Cs-137, 0.145 pCi/g for Sr-90, and -0.131 pCi/g for Ra-226. The trench unit average net residual ROC concentrations were 0.025 pCi/g for Cs-137, 0.078 pCi/g for Sr-90, and 0.310 pCi/g for Ra-226. The net Ra-226 concentration (with background Ra-226 subtracted) was used to calculate the dose and risk. No background was subtracted from the Cs-137 or Sr-90 values since these radionuclides were not naturally occurring or expected due to nuclear weapons testing fallout at pipe depths.

RESRAD modeling using the larger of the MDL or net residual ROC and their decay product concentrations resulted in a dose of 0.4187 mrem/y with an increased cancer risk of 5.434×10^{-6} for the backfill material and 4.345 mrem/y with an increased cancer risk of 7.231×10^{-5} for the trench unit (Yu et. al. 2001). These results were less than the NRC criterion of 25 mrem/y and the increased cancer risk falls within the EPA risk management range of 10^{-6} to 10^{-4} . The modeling parameters, values, and results were presented in Attachments 4 and 5 to the TU314 SUPR (Appendix F).

The results of the modeling efforts determined that the potential TU314 dose due to net residual ROC and their decay product concentrations greater than or equal to the MDL was 4.345 mrem/y with an increased cancer risk of 7.231×10^{-5} , which supports radiological free release. Qualitative ALARA analyses resulted in: 1) no FSS gamma survey measurements above the investigation levels, 2) none of the FSS sample results identified net residual ROC concentrations above the ROC release criteria, 3) no air monitoring results exceeded 10 percent of the derived air concentration for members of the public, and 4) no personnel dosimetry badges processed identified doses above background levels. No further radiological action was recommended in the TU314 SUPR (Appendix F). Table 3-1 summarizes the activities performed during the Parcel C Phase II project area removal action to support the recommended radiological free release of TU314.

7.3.4 TU314 Backfill Activities

Imported fill was selected as the appropriate backfill material for TU314 because there were no suitable radiologically processed and released excavated soil survey units available. The radiological and chemical analytical reports for the imported fill are provided in Appendix K.

Concurrence with backfilling TU314 was obtained from the RASO DON on April 29, 2013, and backfill operations were initiated on May 16, 2013. At the completion of the backfill operations on May 21, 2013, an estimated 967 cubic yards of soil had been placed in TU314 to grade. Road base material was applied over the backfilled trench. Backfill activities were performed in accordance with the HPNS Basewide Construction Specifications (TtEC 2012e). Parcel C Phase II project area restoration activities are described in Section 9.0.

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7.4 TRENCH SURVEY UNIT 333

TU333 is located in the central portion of Work Area 35 within Parcel C along Lockwood Street, west of Drydock No. 3, and west and south of Building 135 (Figures 3-1 and 7-1). TU333 connects to TU334 on the south and terminates on the north at TU136 on Parcel UC2. No IR Program Sites are associated with TU333.

TU333 is composed of two sanitary sewer trench segments and no storm drain trench segments. As identified on Figure 7-1 and Table 3-1, these trench segments include:

- 12-C35-00-1K
- 12-C35-00-1L

Both sanitary sewer trench segments continued into TU334 on the south. Each of the trench segments associated with TU333 was identified in the Design Plan (TtEC 2012d). No manholes were removed from TU333 during the Parcel C Phase II project area removal action activities.

7.4.1 TU333 Removal Action Activities

Excavation activities for TU333 began on June 18, 2013 in sanitary sewer trench segment 12-C35-00-1L. A total of 90 truckloads of soil (approximately 1,080 cubic yards) were excavated from TU333 during the Parcel C Phase II project area removal action (Table 3-3). Soil generated during excavation of TU333 was transferred to RSY4 for radiological processing (Table 3-4). Following completion of the excavation on June 21, 2013, TU333 exhibited an exposed surface area of 844 m² and was 364 linear feet in length (Table 3-1). The maximum excavated TU333 depths ranged between 8 feet and 14 feet bgs (Table 3-2).

A total of 22 sections of pipe were removed from TU333 during the Parcel C Phase II project area removal action and placed on plastic pending further activities (Figure 7-1). The majority of the TU333 piping disintegrated upon removal and was transferred along with the surrounding excavated soil to RSY4 for radiological processing. As indicated in Table 3-2, sanitary sewer trench segment 12-C35-00-1K contained 10-inch-diameter RCP located at depths ranging from 9 feet to 13 feet bgs. Sanitary sewer trench segment 12-C35-00-1L contained 8-inch-diameter VCP located at a depth of approximately 7 feet bgs.

A sufficient volume of sediment was available for sample collection and analysis in one section of pipe removed from trench segment 12-C35-00-1K (sample 12-PCPI-0015-01) during the Parcel C Phase II project area removal action (Table 3-5). No ROC concentrations above the release criteria were identified by the laboratory analytical results for this sediment sample. The sediment sample laboratory analytical reports are provided in Appendix I.

Radiological survey activities were performed for 22 sections of pipe removed from trench segment 12-C35-00-1K, including the pipe section containing the sediment sample (Table 3-6). No elevated survey results were identified for the 22 pipe sections removed from TU333. Based on these results, the sections of TU333 pipe were released and the debris transferred to the DON non-LLRW contractor for off-site disposal or recycling. Copies of the radiological survey reports are presented in Appendix J.

Initially, survey activities were performed and a total of 18 systematic soil samples were collected from the exposed sides and bottom of TU333 on August 2, 2013 and were submitted to the laboratory for analysis. During the survey activities, numerous elevated gamma scan readings were encountered; however, the radioanalytical results of the TU333 soil samples did not identify the presence of ROC concentrations above the release criteria. Based on these results, three investigative soil samples were collected and analyzed. The analytical results identified Ra-226 at concentrations above the NORM Abstract (Appendix A) release limit for one of the samples at 2.341 pCi/g. Due to the presence of Ra-226 contamination above the release limit, approximately 7.5 cubic yards of soil was removed from trench segment 12-C35-00-1K on September 17, 2013 and the material placed in LLRW bin GFLU001234T17 for off-site disposal by the DON radiological waste contractor (Table 3-8). The DON concluded that the persistence of relatively elevated Ra-226 concentrations was likely due to the presence of NORM fill materials as described in Section 2.5.8. A total of six verification soil samples were collected on October 24, 2013 following the remediation efforts and submitted to the laboratory for analysis. The analytical results did not identify the presence of ROC concentrations above the NORM Abstract release criteria (Appendix A).

In total, approximately 7.5 cubic yards of soil was removed from TU333 during the Parcel C Phase II project area removal action and 9 verification soil samples were collected and analyzed in addition to the 18 systematic FSS soil samples (Table 3-1). Figure 7-2 depicts the approximate locations of the Ra-226 soil samples in TU333 associated with the NORM fill materials.

7.4.2 TU333 Piping Remaining in Place

No known storm drain or sanitary sewer systems piping associated with TU333 remained in place within Parcel C following completion of the Phase II time-critical removal action activities.

7.4.3 TU333 Final Status Survey Summary

The original 18 systematic soil samples collected from the exposed sidewalls and bottom of TU333 on August 2, 2013 were submitted to the laboratory for definitive analysis during the Parcel C Phase II project area removal action. No ROC concentrations above the release criteria specified in the NORM Abstract (Appendix A) were identified in the TU333 FSS soil sample analytical results. The NORM Abstract release criteria are specified in Table 2-4. Figure 7-2 depicts the FSS soil sample collection locations in TU333. The range of the gamma scan survey and static survey count rates were presented in Attachment 1 to the TU333 SUPR provided in Appendix F. The laboratory analytical reports for the FSS soil samples were included in Attachment 3 to the TU333 SUPR.

TU333 was defined for the FSS as the sum of the trench unit and the backfill materials composed of both radiologically processed and released excavated soil survey units and a volume of imported fill. The average net residual ROC concentrations for materials used as backfill in TU333 were 0.021 pCi/g for Cs-137, 0.154 pCi/g for Sr-90, and 0.034 pCi/g for Ra-226. The trench unit average net residual ROC concentrations were 0.024 pCi/g for Cs-137, 0.184 pCi/g for Sr-90, and -0.249 pCi/g for Ra-226. The net Ra-226 concentration (with background Ra-226 subtracted) was used to calculate dose and risk. No background was subtracted from the Cs-137 or Sr-90 values since these radionuclides were not naturally occurring or expected due to nuclear weapons testing fallout at pipe depths.

RESRAD modeling using the larger of the MDL or reported net residual ROC and decay product concentrations resulted in a dose of 1.091 mrem/y with an increased cancer risk of 1.585×10^{-5} for the backfill material and 0.6748 mrem/y with an increased cancer risk of 8.702×10^{-6} for the trench unit (Yu et. al. 2001). These results were less than the NRC criterion of 25 mrem/y with an increased cancer risk that falls within the EPA risk management range of 10^{-6} to 10^{-4} . The modeling parameters, values, and results were presented in Attachments 7 and 8 to the TU333 SUPR (Appendix F).

The results of the modeling efforts determined that the potential TU333 dose due to net residual ROC and decay product concentrations greater than or equal to the MDL was 1.091 mrem/y with an increased cancer risk of 1.585×10^{-5} , which supports radiological free release. Qualitative ALARA analyses resulted in: 1) no FSS gamma survey measurements above the investigation levels, 2) none of the FSS sample results identified net residual ROC concentrations above the release criteria specified in Table 2-4, 3) no air monitoring results exceeded 10 percent of the derived air concentration for members of the public, and 4) no personnel dosimetry badges processed identified doses above background levels. No further radiological action was recommended in the TU333 SUPR (Appendix F). Table 3-1 summarizes the activities performed during the Parcel C Phase II project area removal action to support the recommended radiological free release of TU333.

7.4.4 TU333 Backfill Activities

Radiologically processed and released excavated soil survey units and a volume of imported fill were selected as the backfill materials for TU333. The excavated soil survey units selected as backfill material included:

- ES-836
- ES-839

Radiological information related to the processing of these excavated soil survey units is summarized in Table 3-4 and the associated laboratory analytical results are discussed in the TU333 SUPR (Appendix F). The radiological and chemical analytical reports for the imported fill are provided in Appendix K.

With the concurrence of the DON, backfill operations were initiated on February 18, 2014 and completed on May 19, 2014. An estimated 850 cubic yards of soil was placed in TU333 to grade and soil compaction testing was performed. Backfill activities were performed in accordance with the HPNS Basewide Construction Specifications (TtEC 2012e). Asphalt was placed over the backfilled trench during the Lockwood Street paving activities. Parcel C Phase II project area soil compaction and site restoration activities are described in Section 9.0, and the compaction test reports are provided in Appendix N.

7.5 TRENCH SURVEY UNIT 334

TU334 is located in the central portion of Work Area 35 within Parcel C along Lockwood Street, west and southwest of Drydock No. 3 and north of Van Keuren Avenue (Figures 3-1 and 7-1). TU334 connects to TU333 on the north and TU335 on the south. On the west, TU334 terminates at the concrete utility raceway to the west of manhole MH1075. The western portion of TU334 is situated within IR Program Site IR-58. The chemicals of concern associated with IR-58 are listed in Table 3-9.

TU334 is composed of six storm drain trench segments and three sanitary sewer trench segments. As identified on Figure 7-1 and Table 3-1, these trench segments include:

Storm Drain Trench Segments

- 12-C35-00-1G
- 12-C35-00-1H
- 12-C35-00-1I
- 12-C35-00-1J
- 12-C35-00-1N

Sanitary Sewer Trench Segments

- 12-C35-00-1K
- 12-C35-00-1L
- 12-C35-00-1M

- 12-C35-58-1E

Sanitary sewer trench segments 12-C35-00-1K and -1L continue into TU333 on the north and 12-C35-00-1M transitions into TU335 on the south. Storm drain trench segment 12-C35-00-1N extends into TU335 on the south. Each of the trench segments associated with TU334 was identified in the Design Plan (TtEC 2012d).

7.5.1 TU334 Removal Action Activities

Excavation activities for TU334 were initiated on June 17, 2013 in sanitary sewer trench segment 12-C35-00-1M. A total of 71 truckloads of soil (approximately 852 cubic yards) were excavated from TU334 during the Parcel C Phase II project area removal action (Table 3-3). Soil generated during excavation of TU334 was transferred to both RSY3 and RSY4 for radiological processing (Table 3-4). Following completion of the excavation on June 28, 2013, TU334 had an exposed surface area of 699 m² and was 441 linear feet in length (Table 3-1). The maximum excavated TU334 depths ranged between 1 foot and 10 feet bgs (Table 3-2).

A total of 4 manholes (MH1074, MH1075, MH1076, and MH1077) and 11 sections of pipe were removed from TU334 during the Parcel C Phase II project area removal action and placed on plastic pending further activities (Figure 7-1). The majority of the TU334 piping crumbled upon removal and the debris was transferred along with the surrounding excavated soil to RSY3 and RSY4 for radiological processing. As indicated in Table 3-2, storm drain trench segments 12-C35-00-1G and 12-C35-58-1E contained 4-inch-diameter VCP located at depths between 6 feet and 7 feet bgs. Sanitary sewer trench segments 12-C35-00-1K and -1M contained 10-inch-diameter RCP located at depths between 6 and 9 feet bgs. Storm drain trench segment 12-C35-00-1I contained 4-inch-diameter steel pipe located at depths between 1 foot and 2 feet bgs. The remainder of the trench segments contained 8-inch diameter to 15-inch-diameter VCP located at depths ranging from 4 feet to 7 feet bgs.

A sufficient volume of sediment was available for sample collection and analysis in manhole MH1074 (sample 12-PCMH1074-010-01) during the Parcel C Phase II project area removal action (Table 3-5). No ROC concentrations above the release criteria were identified by the laboratory analytical results for this sediment sample. The sediment sample laboratory analytical reports are provided in Appendix I.

Radiological survey activities were performed for manholes MH1074, MH1075, MH1076, and MH1077 and 10 pipe sections removed from trench segment 12-C35-00-1M (Table 3-6). No survey results exceeding the investigation level were identified for manholes MH1074, MH1076, MH1077, or the 10 sections of pipe removed from trench segment 12-C35-00-1M. Based on these results, the concrete and brick materials forming manholes MH1074, MH1076, and MH1077 and the 10 sections of pipe removed from trench segment 12-C35-00-1M were released and the debris

transferred to the DON non-LLRW contractor for off-site disposal or recycling. Due to the narrow 4-inch-diameter pipe section removed from trench segment 12-C35-00-1I, survey activities could not be properly performed. Consequently, this steel pipe section was placed in LLRW bin GFLU002137T1 on August 2, 2013 for disposal by the DON radiological waste contractor. The survey results for manhole MH1075 (survey HPS-PCPIPE-111913-115) identified a net beta/gamma static measurement above the release limit at 1,054 dpm/100 cm². Based on this result, the brick materials forming MH1075 were placed in LLRW bin GFLU002062X1 on March 3, 2014 for off-site disposal by the DON radiological waste contractor. Copies of the radiological survey reports are presented in Appendix J.

Initially, survey activities were performed and a total of 18 systematic soil samples were collected from the exposed sides and bottom of TU334 on August 5, 2013 and submitted to the laboratory for screening analysis. Because numerous elevated gamma scan readings were encountered during the survey activities, five investigative soil samples were also collected and submitted to the laboratory for screening analysis. The analytical results identified the presence of Ra-226 concentrations above the release criterion in two of the soil samples at 2.128 pCi/g and 2.137 pCi/g. However, because the Bi-214 concentration was approximately one-half of the Ra-226 concentration, these samples were submitted to the DoD ELAP-accredited laboratory for definitive analysis. The definitive analytical results identified Ra-226 concentration above the SUPR Abstract release limit in one soil sample at 1.512 pCi/g, but below the NORM Abstract (Appendix A) Ra-226 release limit (Table 2-4). Based on this result, approximately 4.25 cubic yards of soil was removed from trench segment 12-C35-00-1H on September 12, 2013 and placed in LLRW bin GFLU002073T2 for off-site disposal by the DON radiological waste contractor (Table 3-8). Following the remediation efforts, a total of three verification soil samples were collected and submitted to the laboratory for analysis. The laboratory analytical results identified the presence of Ra-226 concentrations above the SUPR Abstract release limit in two of the verification soil samples at 1.680 pCi/g and 1.803 pCi/g; however, the DON concluded that the persistence of relatively elevated Ra-226 radioactivity was likely due to the presence of NORM fill materials as described in Section 2.5.8.

In total, approximately 4.25 cubic yards of soil was removed from TU334 during the Parcel C Phase II project area removal action and 8 (including investigative and verification) soil samples were collected and analyzed in addition to the 18 systematic FSS soil samples (Table 3-1). Figure 7-2 depicts the approximate locations of the Ra-226 soil samples in TU334 associated with the NORM fill materials.

7.5.2 TU334 Piping Remaining in Place

No known storm drain or sanitary sewer systems piping associated with TU334 remained in place within Parcel C following completion of the Phase II time-critical removal action activities.

7.5.3 TU334 Final Status Survey Summary

The original 18 systematic soil samples collected from the exposed sidewalls and bottom of TU334 on August 5, 2013 were submitted to the laboratory for definitive analysis during the Parcel C Phase II project area removal action. No ROC concentrations above the release criteria specified in the NORM Abstract (Appendix A) were identified in the TU334 FSS soil sample analytical results. The NORM Abstract release criteria are specified in Table 2-4. Figure 7-1 depicts the FSS soil sample collection locations in TU334. The range in the gamma scan survey and static survey count rates were presented in Attachment 1 to the TU334 SUPR provided in Appendix F. The laboratory analytical reports for the FSS soil samples were included in Attachment 3 to the TU334 SUPR.

For the FSS, TU334 was defined as the sum of the trench unit and the backfill materials composed of both radiologically processed and released excavated soil and a volume of imported fill. The average net residual ROC concentrations for materials used as backfill were 0.021 pCi/g for Cs-137, 0.149 pCi/g for Sr-90, and -0.066 pCi/g for Ra-226. The trench unit average net residual ROC concentrations were 0.025 pCi/g for Cs-137, 0.058 pCi/g for Sr-90, and -0.038 pCi/g for Ra-226. The net Ra-226 concentration (with background Ra-226 subtracted) was used to calculate dose and risk. No background was subtracted from the Cs-137 or Sr-90 values since these radionuclides were not naturally occurring or expected due to nuclear weapons testing fallout at pipe depths.

RESRAD modeling using the larger of the MDL or net residual ROC concentrations resulted in a dose of 0.4626 mrem/y with an increased cancer risk of 5.998×10^{-6} for the backfill material and 0.2123 mrem/y with an increased cancer risk of 2.860×10^{-6} for the trench unit (Yu et. al. 2001). These results were less than the NRC criterion of 25 mrem/y with an increased cancer risk that falls within the EPA risk management range of 10^{-6} to 10^{-4} . The modeling parameters, values, and results were presented in Attachments 7 and 8 to the TU334 SUPR (Appendix F).

The results of the modeling efforts determined that the potential TU334 dose due to net residual ROC and their decay product concentrations greater than or equal to the MDL was 0.4626 mrem/y with an increased cancer risk of 5.998×10^{-6} , which supports radiological free release. Qualitative ALARA analyses resulted in: 1) no FSS gamma survey measurements above the investigation levels, 2) none of the FSS sample results identified net residual ROC concentrations above the release criteria specified in Table 2-4, 3) no air monitoring results exceeded 10 percent of the derived air concentration for members of the public, and 4) no personnel dosimetry badges processed identified doses above background levels. No further radiological action was recommended in the TU334 SUPR (Appendix F). Table 3-1 summarizes the activities performed during the Parcel C Phase II project area removal action to support the recommended radiological free release of TU334.

7.5.4 TU334 Backfill Activities

Radiologically processed and released excavated soil survey unit ES-838 and a volume of imported fill were selected as the backfill materials for TU334. Radiological information related to the processing of ES-838 is summarized in Table 3-4 and the associated laboratory analytical results are discussed in the TU334 SUPR (Appendix F). The radiological and chemical analytical reports for the imported fill are provided in Appendix K.

With the concurrence of the DON, backfill operations were initiated on February 18, 2014 and completed on May 16, 2014. An estimated 556 cubic yards of soil was placed in TU334 to grade and soil compaction testing was performed. Backfill activities were performed in accordance the HPNS Basewide Construction Specifications (TtEC 2012e). Asphalt was placed over the backfilled trench during the Lockwood Street paving activities. Parcel C Phase II project area soil compaction and site restoration activities are described in Section 9.0. The compaction test reports are provided in Appendix N.

7.6 TRENCH SURVEY UNIT 335

Physically separated into two distinct sections, TU335 is located in the south central portion of Work Area 35 within Parcel C (Figures 3-1 and 7-1). One section of TU335 is situated along Lockwood Street and connects to TU334 on the north and TU203 on the south, which was excavated during the first phase of the Parcel C removal action. The second section of TU335 is located west of the Lockwood Street and Van Keuren Avenue intersection and connects to Trench Survey Unit 194 on the south, which was excavated during the first phase of the Parcel C removal action. On the north, this section of TU335 terminated abruptly on the north when no further piping was found after several excavation attempts. The second section of TU335 is situated within IR Program Site IR-58. No additional IR Program Sites are associated with TU335. The chemicals of concern associated with IR-58 are listed in Table 3-9.

TU335 is composed of one storm drain trench segment and six sanitary sewer trench segments. As identified on Figure 7-1 and Table 3-1, these trench segments include:

Storm Drain Trench Segment

- 12-C35-00-1N

Sanitary Sewer Trench Segments

- 12-C35-00-1M
- 12-C35-58-1A
- 12-C35-58-1B
- 12-C35-58-1D
- 12-C35-58-1F
- 12-C35-58-8A

Storm drain trench segment 12-C35-00-1N and sanitary sewer trench segment 12-C35-00-1M continue into TU334 on the north. With the exception of sanitary sewer trench segment 12-C35-58-8A, each of the trench segments associated with TU335 was identified in the Design Plan (TtEC 2012d). Trench segment 12-C35-58-8A was found during excavation of trench segment 12-C35-58-1D.

7.6.1 TU335 Removal Action Activities

Excavation activities for TU335 commenced on June 14, 2013 in sanitary sewer trench segment 12-C35-00-1M. A total of 62 truckloads of soil (approximately 744 cubic yards) were excavated from TU335 during the Parcel C Phase II project area removal action (Table 3-3). Soil generated during excavation of TU335 was transferred to both RSY3 and RSY4 for radiological processing (Table 3-4). Following completion of the excavation on June 27, 2013, TU335 exhibited an exposed surface area of 677 m² and was 453 linear feet in length (Table 3-1). The maximum excavated TU335 depths ranged between 4 feet and 8 feet bgs (Table 3-2).

A total of two manholes (MH1346 and MH1347) and nine sections of pipe were removed from TU335 during the Parcel C Phase II project area removal action and placed on plastic pending further activities (Figure 7-1). The majority of the TU335 piping disintegrated upon removal and the debris was transferred along with the surrounding excavated soil to RSY3 and RSY4 for radiological processing. As indicated in Table 3-2, storm drain trench segment 12-C35-00-1N contained 15-inch-diameter VCP located at a depth of approximately 7 feet bgs. Sanitary sewer trench segment 12-C35-00-1M contained 10-inch-diameter RCP located at a depth of approximately 6 feet bgs and 12-C35-58-8A contained 4-inch-diameter CIP located at a depth of about 3 feet bgs. The remaining sanitary sewer trench segments contained 6-inch-diameter VCP located at depths ranging from 3 feet to 5 feet bgs.

A sufficient volume of sediment was available for sample collection and analysis in one section of RCP removed from sanitary sewer trench segment 12-C35-00-1M (sample 12-PCPI-0014-01) during the Parcel C Phase II project area removal action (Table 3-5). No ROC concentrations above the release criteria were identified by the laboratory analytical results for this sediment sample. The sediment sample laboratory analytical reports are provided in Appendix I.

Radiological survey activities were performed for manholes MH1346 and MH1347, and nine sections of pipe removed from trench segment 12-C35-00-1M during the removal action activities (Table 3-6). No elevated survey results were identified for manhole MH1347 or the nine sections of trench segment 12-C35-00-1M RCP. Based on these results, the brick material forming MH1347 and the nine sections of pipe removed from trench segment 12-C35-00-1M were released and the debris transferred to the DON non-LLRW contractor for off-site disposal or recycling. The survey results for manhole MH1346 (survey HPS-PCPIPE-021214-116) identified net alpha and net beta/gamma static measurements above the release limits at 235 dpm/100 cm² and 1,439

dpm/100 cm², respectively. Consequently, the brick materials forming MH1346 were placed in LLRW bin CVGU001161X1 on March 3, 2014 for off-site disposal by the DON radiological waste contractor. Copies of the radiological survey reports are presented in Appendix J.

Initially, survey activities were performed and a total of 18 systematic soil samples were collected from the exposed side and bottom of TU335 on July 31, 2013 and submitted to the laboratory for screening analysis. Because numerous elevated gamma scan readings were encountered during the survey activities, five investigative soil samples were also collected and submitted to the laboratory for screening analysis. The screening laboratory analytical results identified Ra-226 radioactivity concentrations above the SUPR Abstract release limit in 10 of the 18 systematic soil samples and two of the investigative soil samples ranging from 1.596 pCi/g to 1.902 pCi/g. Subsequently, the original 18 systematic soil samples were submitted to the DoD ELAP accredited laboratory for definitive analysis. The definitive laboratory results identified the presence of a Ra-226 concentration above the SUPR Abstract release limit in one soil sample at 1.732 pCi/g, but below the NORM Abstract Ra-226 release limit. Based on these results, approximately 3.5 cubic yards of soil was removed from trench segment 12-C35-00-1N on September 12, 2013 and placed in LLRW bin GFLU002073T2 for off-site disposal by the DON radiological waste contractor (Table 3-8). In addition, an estimated 3.5 cubic yards was removed from trench segment 12-C35-58-1F and about 2.5 cubic yards was removed from trench segment 12-C35-00-1N on September 13, 2013 and placed in LLRW bin GFLU002137T1 for off-site disposal by the DON radiological waste contractor. Following the remediation efforts, a total of nine verification soil samples were collected and submitted to the laboratory for analysis. The laboratory analytical results identified Ra-226 concentrations above the SUPR Abstract release limit in three of the verification soil samples at 1.521 pCi/g, 1.646 pCi/g, and 1.656 pCi/g, but below the NORM Abstract (Appendix A) Ra-226 release limit. The DON concluded that the persistence of relatively elevated Ra-226 activity was likely due to the presence of NORM fill materials as described in Section 2.5.8.

In total, approximately 9.5 cubic yards of soil was removed from TU335 during the Parcel C Phase II project area removal action and 14 soil samples (including investigative and verification) were collected and analyzed in addition to the 18 systematic FSS soil samples (Table 3-1). Figure 7-2 depicts the approximate locations of the Ra-226 soil samples in TU335 associated with the NORM fill materials.

7.6.2 TU335 Piping Remaining in Place

No known storm drain or sanitary sewer systems piping associated with TU335 remained in place within Parcel C following completion of the Phase II time-critical removal action activities.

7.6.3 TU335 Final Status Survey Summary

The original 18 systematic soil samples collected from the exposed sidewalls and bottom of TU335 on July 31, 2013 were submitted to the laboratory for definitive analysis during the Parcel C Phase

II project area removal action. No ROC concentrations above the release criteria specified in the NORM Abstract (Appendix A) were identified in the TU335 FSS soil sample analytical results. The NORM Abstract release criteria are specified in Table 2-4. Figure 7-1 depicts the FSS soil sample collection locations in TU335. The range in the gamma scan survey and static survey count rates were presented in Attachment 1 to the TU335 SUPR provided in Appendix F. The laboratory analytical reports for the FSS soil samples were included in Attachment 3 to the TU335 SUPR.

TU335 was defined for the FSS as the sum of the trench unit and the backfill materials composed of both radiologically processed and released excavated soil and a volume of imported fill. The average net residual ROC concentrations for materials used as backfill were 0.020 pCi/g for Cs-137, 0.152 pCi/g for Sr-90, and -0.077 pCi/g for Ra-226. The trench unit average net residual ROC concentrations were 0.025 pCi/g for Cs-137, 0.069 pCi/g for Sr-90, and -0.006 pCi/g for Ra-226. The net Ra-226 concentration (with background Ra-226 subtracted) was used to calculate dose and risk. No background was subtracted from the Cs-137 or Sr-90 values since these radionuclides were not naturally occurring or expected due to nuclear weapons testing fallout at pipe depths.

RESRAD modeling using the larger of the MDL or net residual ROC and their decay product concentrations resulted in a dose of 0.4556 mrem/y with an increased cancer risk of 5.901×10^{-6} for the backfill material and 0.2372 mrem/y with an increased cancer risk of 3.174×10^{-6} for the trench unit (Yu et. al. 2001). These results were less than the NRC criterion of 25 mrem/y and the increased cancer risk falls within the EPA risk management range of 10^{-6} to 10^{-4} . The modeling parameters, values, and results were presented in Attachments 7 and 8 to the TU335 SUPR (Appendix F).

The results of the modeling efforts determined that the potential TU335 dose due to net residual ROC and their decay product concentrations greater than or equal to the MDL was 0.4556 mrem/y with an increased cancer risk of 5.901×10^{-6} , which supports radiological free release. Qualitative ALARA analyses resulted in: 1) no FSS gamma survey measurements above the investigation levels, 2) none of the FSS sample results identified net residual ROC concentrations above the release criteria specified in Table 2-4, 3) no air monitoring results exceeded 10 percent of the derived air concentration for members of the public, and 4) no personnel dosimetry badges processed identified doses above background levels. No further radiological action was recommended in the TU335 SUPR (Appendix F). Table 3-1 summarizes the activities performed during the Parcel C Phase II project area removal action to support the recommended radiological free release of TU335.

7.6.4 TU335 Backfill Activities

Radiologically processed and released excavated soil survey unit ES-840 and a volume of imported fill were selected as the backfill materials for TU335. Radiological information related to the processing of ES-838 is summarized in Table 3-4 and the associated laboratory analytical results

are discussed in the TU335 SUPR (Appendix F). The radiological and chemical analytical reports for the imported fill are provided in Appendix K.

With the concurrence of the DON, backfill operations were initiated on February 12, 2014 and completed on May 16, 2014. An estimated 454 cubic yards of soil was placed in TU335 to grade and soil compacting testing was performed. Backfill activities were performed in accordance with the HPNS Basewide Construction Specifications (TtEC 2012e). Asphalt was placed over the backfilled trench during the Lockwood Street paving activities. Parcel C Phase II project area soil compaction and site restoration activities are described in Section 9.0. The compaction test reports are provided in Appendix N.

8.0 SHIP BERTHS 1, 2, 3, 4, AND 5

Ship Berths 1, 2, 3, 4, and 5 are located between Drydocks 2 and 4 on the eastern and southern boundaries of Parcel C along the edges of Work Areas 31 and 34. Ship Berths 1 and 2 are bound by A Street on the west and Parcel F on the east. Ship Berths 3 and 4 are situated south of Nimitz Avenue and north of North Pier, and Ship Berth 5 is located east of non-radiologically impacted Building 236 along the eastern side of Work Area 31 and adjacent to North Pier (Figure 8-1). The following sections summarize the radiological work activities completed for Ship Berths 1, 2, 3, 4, and 5 during the time-critical removal action, provide an abbreviated history, describes the survey results, and discusses regulatory concurrence for the unrestricted radiological release of the site. The details and results of the Ship Berths 1, 2, 3, 4, and 5 radiological activities were presented in the FSS report provided in Appendix G. The location of Ship Berths 1, 2, 3, 4, and 5 within the context of Parcel C is depicted on Figures 1-3, 3-1, and 8-1.

8.1 DESCRIPTION

The Ship Berths 1, 2, 3, 4, and 5 area extended 42 feet inland from the San Francisco Bay and included the associated concrete structures, utility pads, vaults, piping, and other infrastructure within the Parcel C Phase II project area (Figure 8-1). Ship Berths 1 and 2 were composed of cantilevered concrete structures measuring 42 feet wide and 821 feet long (Figure 8-2). Ship Berths 3, 4, and 5 consisted of a 1,706 foot long asphalt surface underlain with fill material that extended 42 feet inland from the quay wall at the water's edge (Figure 8-3).

The amended SFRA Redevelopment Plan (SFRA 2010) indicated that the area was designated for open space. Currently, Ship Berths 1, 2, 3, 4, and 5 are unoccupied.

8.2 BACKGROUND

Volume II of the HRA (NAVSEA 2004) indicated that Ship Berths 1, 2, 3, 4, and 5 were previously used for berthing of OPERATION CROSSROADS ships, berthing of the YGN-73 (radioactive waste disposal barge), and for NRDL use including berthing of experimental ships YAG-39 and YAG-40.

The ROC selected in Volume II of the HRA (NAVSEA 2004) for Ship Berths 1, 2, 3, 4, and 5 included Cs-137, Pu-239, Ra-226, and Sr-90. These radionuclides covered the alpha, beta, and gamma emitters that may have been present at Ship Berths 1, 2, 3, 4, and 5. Table 2-1 identifies the release criteria specified in the AM (DON 2006) and Table 2-2 presents the remediation goals established in the ROD (DON 2010) for these ROC.

8.3 FINAL STATUS SURVEY

TtEC mobilized to perform the FSS activities for Ship Berths 1,2,3,4, and 5 in December 2012 using guidance presented in MARSSIM (NUREG-1575; DoD et al. 2000). A task-specific plan for the radiological survey activities was prepared for Ship Berths 1, 2, 3, 4, and 5 and submitted to the **RASO-DON** for review. A copy of the task-specific plan was provided in Appendix K to the Ship Berths 1, 2, 3, 4, and 5 FSS report (Appendix G). The primary goals of the FSS activities for Ship Berths 1, 2, 3, 4, and 5 were to:

- Perform a preliminary contamination assessment.
- Assess general levels and the extent of radionuclide contamination, if found.
- Identify, remove, and dispose of any contaminated materials as LLRW.
- Conduct an FSS and assess the radiological status to determine the increase in dose and excess lifetime cancer risk to members of the general public using a “residential farmer” scenario in the most current version of RESRAD (Version 6.5) and RESRAD-Build (Version 3.5) (Yu et. al. 2001, Yu et. al. 2003).

The objective of the survey activities was to demonstrate that residual ROC levels were less than the release criteria specified in the AM (DON 2006) and the remediation goals established in the ROD (DON 2010). Each of the 13 survey units associated with Ship Berths 1, 2, 3, 4, and 5 was surveyed to determine whether residual concentrations exceeded the NCP acceptable risk management range of 10^{-6} to 10^{-4} to a member of the critical group, and if the residual radioactivity had been reduced to levels that were ALARA. This radiological release process ensured that residual radioactivity did not result in individuals being exposed to unacceptable levels of radiation or radioactive materials. The unrestricted release criteria for the Ship Berths 1, 2, 3, 4, and 5 FSS is summarized in Section 3.2.2.

The background or reference area for radiological surveys was presented in the task-specific plan provided in Appendix K to the Ship Berths 1, 2, 3, 4, and 5 FSS report (Appendix G). Building 803 was selected for use as the background reference area for the concrete survey units because it was constructed in a similar era to Ship Berths 1, 2, 3, 4, and 5, it was constructed of similar materials, and it was not listed as impacted in Volume II of the HRA (NAVSEA 2004). Figure 8-1 shows the location of Building 803. In addition, concrete risers, metallic bollards, and cleats from the Drydock 2 area were used as background area components. A study detailing the elevated alpha surface activity identified on pier components due to environmental conditions resulting in a combination of static charge and environmental radon progeny leading to the use of Drydock 2 as background materials was provided in Appendix L to the Ship Berths 1, 2, 3, 4, and 5 FSS report (Appendix G). Located in Parcel D-1, the area between Building 526 and Ship Berth 29 was used as the reference area for the Ship Berths 1, 2, 3, 4, and 5 soil survey units 2 through 9 because its surroundings, vegetation, and overall topography were similar and this area had no history of

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radiological use. Based on a geological analysis of the soil in survey unit 1, a more appropriate background reference area was collected in December 2013 from an unimpacted area to the southeast of Lockwood Avenue. Figure 8-1 shows the locations of the two soil background reference areas.

The 9,592 m² Ship Berths 1, 2, 3, 4, and 5 area was divided into 13 Class 1 survey units for the time-critical removal action. Survey Units 1 through 9 were asphalt/soil survey units associated with Ship Berths 2, 3, 4, and 5 and Survey Units 10 through 13 were concrete survey units associated with Ship Berths 1 and 2. Each of the 13 survey units was less than 800 m² in area. No Class 2 survey units were associated with Ship Berths 1, 2, 3, 4, and 5. Figure 8-1 depicts the arrangement of the Class 1 survey units designated for Ship Berths 2 through 5 and Figure 8-2 depicts the arrangement of the Class 1 survey units designated for Ship Berths 1 and 2. Table 8-1 lists each of the Ship Berths 1, 2, 3, 4, and 5 survey units, provides the area in m², and identifies the media and associated Ship Berths.

Initially, a gamma scan was completed on the existing asphalt surfaces covering Survey Units 1 through 9. The resulting data were used to plan and manage the Ship Berths 2, 3, 4, and 5 asphalt removal activities. Gamma scan readings exceeding the investigation limit were identified in several grids identified as A9, A12, A13, and A20 through A32. Gamma static measurements were collected to verify the elevated scan readings. A section of asphalt in grid A12 was removed and placed in LLRW bins for off-site disposal by the DON radiological waste contractor. Additional samples of the soil were collected due to the presence of contamination found beneath the asphalt in grid A12. The remaining asphalt was removed and staged pending receipt of the soil sample laboratory analytical results. Asphalt sections were disposed of as LLRW if previously covering soil was found to have ROC concentrations exceeding the release criteria. A total of 365 cubic yards of asphalt was disposed of as LLRW during the removal action. The remaining asphalt was staged for recycling.

Rail tracks, plates, spikes, and other materials present on Ship Berths 1, 2, 3, 4, and 5 were removed and surveyed during the Parcel C Phase II time-critical removal action. Items verified to exceed the Regulatory Guide 1.86 limits specified for Pu-239 and Ra-226 (gross alpha surface concentration of 100 dpm/100 cm²) and Sr-90 (gross beta surface concentration of 1,000 dpm/100 cm²) were placed in LLRW bins for off-site disposal by the DON radiological waste contractor. The survey results were provided in Appendix D to the Ship Berths 1, 2, 3, 4, and 5 FSS report (Appendix G).

Separate pier components, such as concrete risers, metallic cleats, and metallic bollards, were surveyed as materials and equipment in accordance with the Execution Plan (TtEC 2012c). The survey results were provided in Appendix D to the Ship Berths 1, 2, 3, 4, and 5 FSS report (Appendix G). A study that described the combination of environmental effects and naturally

occurring radon progeny on pier components was conducted and the results presented in “The Elevated Surface Activity on Pier Components.” This study was provided in Appendix L to the Ship Berths 1, 2, 3, 4, and 5 FSS report (Appendix G). A total of 29 areas exhibited fixed surface activity exceeding the release criteria; however, these results were likely due to a combination of environmental effects and naturally occurring radon progeny. Because these pier components were large structures that could not easily be removed in a safe manner, and the elevated measurements did not appear to be representative of radioactive contamination, the pier components remained in place and were considered by the DON to be radiologically free of contamination.

During the survey activities, 100 percent of each of the 13 Class 1 survey units was scanned with either a ~~RASO-approved drive-over array system~~ or a Ludlum Model 2350-1 survey meter equipped with a Ludlum 44-10 2-inch by 2-inch NaI detector. Gamma scan readings were logged and a number of elevated readings were tagged for additional survey activities. Alpha and beta scans were performed over 100 percent of the concrete surfaces in Survey Units 10 through 13 in addition to the gamma scans. Biased measurements were collected at those locations showing readings greater than the investigation level. The results of the alpha, beta, and gamma scans and investigative measurements at biased locations were provided in Appendix F to the Ship Berths 1, 2, 3, 4, and 5 FSS report (Appendix G).

VSP software was used to select 27 systematic locations for the collection of static measurements on the concrete survey units (Survey Units 10 through 13) and 20 systematic locations for sample collection in the soil survey units (Survey Units 1 through 9) using a triangular grid with a random start point (PNL 2007). A minimum of two biased static measurements and sample collection locations were obtained in the areas with the most elevated gamma measurements in the soil survey units (Survey Units 1 through 9). Static measurements exceeded the investigation level in Survey Units 1 through 7 and 11 through 13. A review of the data showed that if the corresponding gamma spectroscopy analytical results did not exceed the release criteria, the elevated static gamma measurements were likely the result of the naturally occurring radionuclides, including K-40 and the Th-232 decay series (as evidenced by actinium-228). The static measurements were provided in Appendix F to the Ship Berths 1, 2, 3, 4, and 5 FSS report (Appendix G).

Biased and systematic sample collection activities for the Class 1 Survey Units 1 through 9 began in March 2013. Sample collection and remediation activities were performed for each survey unit, as appropriate. In total, 357 soil samples were collected and analyzed, and approximately 140 cubic yards of soil was removed from Survey Units 1 through 9 during the time-critical removal action and placed in LLRW bins for off-site disposal by the DON radiological waste contractor. The highest Cs-137 concentration of 0.4069 pCi/g was identified in Survey Unit 5 and the highest Ra-226 concentration of 170.1 pCi/g was found in Survey Unit 4.

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A total of 27 systematic alpha and beta static measurements and swipe samples were collected from concrete Survey Units 10 through 13 during the removal action. None of the FSS static or swipe measurements exceeded the release criteria and no swipe measurement indicated the presence of loose surface activity greater than 20 percent of the release criteria. The maximum net alpha and beta removable contamination within any survey units was 5.61 dpm/100 cm² for alpha activity and 16.09 dpm/100 cm² for beta activity. Table 8-1 summarizes radiological information for each of the 13 survey units that led to the DON's recommendation for free release of Ship Berths 1, 2, 3, 4, and 5.

Demobilization for Ship Berths 1, 2, 3, 4, and 5 occurred in September 2014. The equipment used during the survey activities was verified to be less than the Regulatory Guide 1.86 (AEC 1974) limits specified for Cs-137, Pu-239, Ra-226, and Sr-90. The equipment (which included instrumentation, tools, etc.) was then unconditionally released back to the applicable vendor for unrestricted use.

Ship Berths 1, 2, 3, 4, and 5 were subjected to reviews to ensure that radiation exposure to workers, the public, and the environment met ALARA principles. These reviews were conducted for operations, practices, and procedures with potential for exceeding individual (1 millirem) or collective (10 person-rem) doses. Much of the data and analysis used for environmental ALARA evaluations were developed as part of the routine work processes. Results from radiological survey activities, and air, swipe, and soil samples were used to assess the radiological impacts of the Ship Berths 1, 2, 3, 4, and 5 activities. These activities included characterization to ensure complete removal of radioactive material exceeding the release criteria. Following the completion of survey activities, qualitative radiological impacts from operations were evaluated by performing a dose and risk assessment. Based on recent estimates of dose to the public from Ship Berths 1, 2, 3, 4, and 5 survey activities, only qualitative ALARA analyses were required. Qualitative ALARA analyses for Ship Berths 1, 2, 3, 4, and 5 did not result in the identification of FSS alpha or beta measurements above the investigation levels and none of the alpha, beta, or gamma measurements identified ROC concentrations above the release criteria. A description of the ALARA process is presented in Section 3.2.8 of this RCSR and detailed in the Ship Berths 1, 2, 3, 4, and 5 FSS report (Appendix G).

The intent of the Ship Berths 1, 2, 3, 4, and 5 FSS is to achieve unrestricted radiological release of the site. The criterion for unrestricted release was an increased excess lifetime cancer risk that fell within the NCP acceptable risk management level of 10⁻⁶ to 10⁻⁴, and whether the residual radioactivity had been reduced to levels that were ALARA. To calculate the excess lifetime cancer risk and residual dose, the residential farmer scenario in RESRAD Version 6.5 was used for Survey Units 1 through 9 (Yu et. al. 2001). For Survey Units 10 through 13, the building occupancy scenario in RESRAD-BUILD Version 3.5 was used (Yu et. al. 2003). A detailed summary of the dose and risk modelling performed is provided in Section 3.2.7.

For Class 1 survey units where the net mean activity was less than zero, the residual dose was determined to be 0.00 mrem/y, with a zero percent increase in excess lifetime cancer risk. No other dose or risk modeling for these survey units was determined to be necessary.

The modeling input parameters provided that if the reported activity was less than the MDL, then the MDL was used. The maximum dose and excess lifetime cancer risk when using the higher of the reported net residual ROC concentrations or the MDL were 3.349 mrem/y with an excess lifetime cancer risk of 5.384×10^{-5} in Survey Unit 2. Based on these results, the DON recommended Ship Berths 1, 2, 3, 4, and 5 for unrestricted release. A summary of the final dose and risk modeling results is presented in Table 8-1. The RESRAD-BUILD Version 3.5 and RESRAD Version 6.5 dose and risk models were presented in Appendix J to the Ship Berths 1, 2, 3, 4, and 5 FSS report (Appendix G) (Yu et. al. 2001, Yu et. al. 2003).

8.4 REGULATORY CONCURRENCE

The DON submitted the final Ship Berths 1, 2, 3, 4, and 5 FSS report to the regulatory agencies on August 10, 2017. DTSC issued “no further comments” with the FSS report on October 16, 2017. A copy of the letter is provided in Appendix O. Concurrence with the radiological release for unrestricted use of Ship Berths 1, 2, 3, 4, and 5 was obtained from the DTSC in a letter dated _____ and in a CDPH memorandum dated _____. The CDPH based its concurrence on the results of the FSS and its own confirmation surveys performed on August 31, 2016. Copies of the DTSC regulatory release for unrestricted use letter and the CDPH memorandum are provided in Appendix O.

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9.0 PARCEL C PHASE II PROJECT AREA SITE RESTORATION AND TEMPORARY SWALE CONSTRUCTION

Site restoration and temporary swale installation activities were performed for the Parcel C Phase II project area following the completion of the excavation and backfill of the trench survey units. The primary goals of these activities were for stormwater management, dust and sediment control, and restoring the main traffic corridor through HPNS. Details of these activities are described in the following sections.

9.1 SITE RESTORATION

Backfill material was placed in 2-foot-thick loose lifts using radiologically surveyed and released excavated soil, imported fill, or a combination of the two. The backfill soil placed in the trench survey units was then compacted by pressing the material down using mechanical compaction equipment. This process was repeated until the appropriate elevation and slope was achieved at approximately 4 feet below final grade in roadway trenches on Lockwood Street and 2 feet below final grade for non-roadway trenches. The remaining 4 feet were backfilled with imported fill for the roadway trenches. For non-roadway trenches, the remaining 2 feet were backfilled with radiologically released excavated soil and/or imported fill. Backfill and compaction activities for the storm drain and sanitary sewer systems excavations were performed in accordance with the Execution Plan (TtEC 2012c) and the Basewide Construction Specifications (TtEC 2012e) provided in the Design Plan (TtEC 2012d).

To ensure that the imported fill would meet compaction requirements, the material was visually inspected prior to placement to verify that it consisted of well-graded sands and gravels that did not contain particles greater than 2 inches in diameter. Samples of the imported fill were evaluated using the American Society for Testing and Materials (ASTM) D422-63 sieve analysis. ASTM D1557-12 maximum dry density and optimum moisture content at a frequency of one sample per 5,000 cubic yards were used to determine the compaction of the backfill material using a nuclear density gauge for roadway trenches only.

Once the proper elevation and slope were achieved in the roadway trenches, the imported fill was placed in 1-foot lifts using a small double drum vibratory roller and a big smooth drum vibratory roller for each lift. For elevations 3 feet bgs and above, compaction testing was performed for each 1-foot-lift interval with a minimum rate of one test per every 50 linear feet of backfilled trench to verify that a relative compaction of 95 percent or greater was achieved. Compaction testing was performed in accordance with ASTM D6938-10 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth). Test locations and compaction results are depicted on Figure 9-1. The compaction test reports are provided in Appendix N.

Five inches of Class II base rock with 1.5 percent lime was placed over the compacted imported fill in roadway areas followed by 6 inches of new asphalt to restore Lockwood Street to pre-excavation levels and surrounding unexcavated conditions. In addition, a double yellow center line and two white roadway edge lines were painted on the streets in accordance with the California Manual on Uniform Traffic Control Devices for Streets and Highways (CA MUTCD 2012) to complete the restoration activities.

For non-roadway trenches, the final 2 feet were placed in 1-foot lifts. Compaction was performed using equipment compatible to the backfill material as described in the NAVFAC "Foundations & Earth Structures, Design Manual 7.2" (NAVFAC 1986). Stockpiled road base (recycled asphalt) material was placed over the compacted released excavated soil and/or imported fill to levels consistent with pre-excavation and surrounding conditions.

9.2 TEMPORARY SWALE CONSTRUCTION

To temporarily replace the removed underground storm drain systems, a surface-based system consisting of 780 linear feet of drainage swale, 760 linear feet of piping, and 3 catch basins were installed to direct overland stormwater runoff from Parcel C and the SFRA property (formerly Parcel A) to the active storm drain system piping and outfalls. The temporary swale system is depicted on Figure 9-2. The surface stormwater system was designed to handle a 2-year return period storm. The design calculations were based on 1.05 inches of rainfall per hour. The constructed system was designed to remove stormwater at a rate of 10.5 to 25.6 cubic feet per second or approximately 4,713 to 11,490 gallons per minute. The design of the swale provided for trapping sediments and a gradual slope for gravity flow as stormwater controls.

The stormwater system included the construction of one drainage rock swale, one underground piping system, and three catch basins in the Parcel C Phase II project area. The swale was constructed along the middle of Blandy Street and the underground piping system was constructed along the edge of Lockwood Street on the west side of Building 253. The swale was designed to be continuous and collect stormwater runoff from the roadways, adjacent buildings, the Parcel C Phase I drainage system on the west, and the SFRA property (formerly Parcel A) to the north. The underground piping system was designed to collect stormwater runoff from the roadways, adjacent buildings, and the Parcel C Phase I drainage system on the east. Although previously requested, no stormwater volume calculations were provided by the SFRA for discharges to the HPNS swale system. Consequently, the temporary design could only be based on the typical 2-year return period storm. Details for the swale construction were presented in the Design Plan (TtEC 2012d). The drainage details and tie-ins to the existing drainage system are depicted on Figures 9-3 through 9-7.

The design included the construction of one temporary rock swale along the center of Blandy Street to effectively capture stormwater from the roadways, adjacent buildings, the Parcel C Phase

I drainage system on the west and the SFRA property (formerly Parcel A). The temporary rock swale was constructed along previously removed underground piping in Parcel C Phase II. The swale has a minimum top width of 8 feet with a minimum depth of 2.5 feet and is lined with 1.5-inch drain rock. The swale was designed to have a traffic crossing section by Building 203 to and from Nimitz Avenue. The crossing section was constructed with an underground 24-inch-diameter smooth corrugated pipe with a catch basin at the low point to collect stormwater runoff from the area. The catch basins were comprised of precast concrete and welded galvanized grates rated for H-20 traffic loading. The swale system discharges to an existing outfall by Ship Berth 5 in Parcel C via a new underground 24-inch-diameter pipe.

The underground piping system runs along the edge of Building 253 on Lockwood Street. The underground piping system was designed to collect stormwater runoff from the roadways, adjacent buildings, and the Parcel C Phase I drainage system to the east. The underground piping system was constructed with 18-inch-diameter smooth corrugated pipe and two catch basins. The catch basins were placed at low points to collect stormwater from the roadway and adjacent buildings. The catch basins were comprised of precast concrete and welded galvanized grates rated for H-20 traffic loading. The underground piping system discharges to an existing outfall by Ship Berth 3 in Parcel C via a new underground 18-inch-diameter pipe.

9.3 FINAL FIELD INSPECTIONS

Representatives from the DON Caretaker Site Office (CSO) and Resident Officer in Charge of Construction (ROICC) performed final inspection of TU312, TU313, and TU314 at Building 134 in Work Area 35 on June 25, 2013. The purpose of this inspection was to accept the fieldwork performed by TtEC prior to transferring control of the area to another DON contractor for chemical contamination remediation activities. The CSO and ROICC representatives certified that the inspection was satisfactorily completed and the TU312, TU313, and TU314 area acceptable on June 25, 2013. A copy of the inspection report is provided in Appendix P.

The CSO and ROICC performed an inspection of TU315 through TU339 and the site restoration paving of Lockwood Street on June 24, 2014. Four items were observed by the CSO and ROICC that required remedy prior to certification and approval for closure. The observed items included marking the rail on Lockwood Street with orange paint, installing a stop sign, picking up debris, and placing additional rock in the constructed swale. TtEC remedied each of the four items on June 27, 2014. The CSO and ROICC certified that the observed items were complete and approved TU315 through TU339 and site restoration paving of Lockwood Street on July 1, 2014. A copy of the inspection report is provided in Appendix P.

On October 7, 2014, the CSO and ROICC performed an inspection of the Ship Berths 1, 2, 3, 4, and 5 area. The CSO and ROICC observed that general housekeeping needed to be performed prior to certification and approval for closure. TtEC completed housekeeping efforts on October

6, 2014. The CSO and ROICC certified that housekeeping was complete and approved the Ship Berths 1, 2, 3, 4, and 5 area for closure on October 7, 2014. A copy of the final inspection report is proved in Appendix P.

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10.0 PARCEL C PHASE II PROJECT AREA ESTIMATED COST SUMMARY

This section provides a summary of the estimated costs incurred in performing the second phase of the Parcel C time-critical removal action activities. The cost of this second phase of the removal action is approximate due to numerous factors including changes in site conditions and overlapping removal action activities performed for other HPNS parcels within the same period of time.

<u>ACTIVITY</u>	<u>ESTIMATED COST</u>
Storm Drain and Sanitary Sewer Systems Removal	\$ 2,885,341
Remediation (including laboratory costs)	\$ 5,260,572
Site Restoration	\$ 1,222,131
LLRW Disposal	\$ 4,687,900
Ship Berths 1, 2, 3, 4, and 5 FSS	\$ 1,119,759
Estimated Total	<u>\$ 15,175,702</u>

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11.0 CONCLUSIONS AND RECOMMENDATION

This RCSR was prepared at the direction of the DON to describe and summarize the Parcel C Phase II project area Ship Berths 1, 2, 3, 4, and 5 FSS activities, and storm drain and sanitary sewer time-critical removal action activities. The Parcel C Phase II project area radiological removal action was performed to protect the public health and welfare, and the environment from actual or potential releases of radiologic contaminants. The removal action activities were directed by the DON with the support of the RASO. This time-critical removal action was conducted in accordance with the requirements of CERCLA as amended by SARA and, to the extent practicable, the NCP. Except in relation to reuse as potential backfill material or waste characterization for disposal of excavated soil derived from the removal of the Parcel C Phase II project area storm drain and sanitary sewer systems, this RCSR did not address chemical contamination and did not include or affect any other designated HPNS parcels.

The 73 acre Parcel C property is located on the east side of HPNS. The western portion of Parcel C comprises the original promontory, while the majority of Parcel C is situated in the lowlands with surface elevations between zero and ten feet above mean sea level. The Parcel C Phase II project area includes Ship Berths 1, 2, 3, 4, and 5, as well as selected storm drain and sanitary sewer systems within Work Areas 31, 33, 34, and 35. Some of the storm drain and sanitary sewer systems piping was not addressed during this phase of the Parcel C time-critical removal action. The remainder of the Parcel C storm drain and sanitary sewer systems may be addressed during future Parcel C removal actions. In addition, this RCSR does not include radiologically impacted Building 205 and associated discharge channel, Buildings 211, 224, or 253. These structures likely will be addressed during future Parcel C radiological contracts.

Based on its radiological operational history and site-specific investigative data, the DON determined that potential low-level radioactive contamination in some buildings, storm drain and sanitary sewer lines, soil, debris, and slag material at HPNS required a response action. This decision was documented in the AM (DON 2006). The purpose of the AM was to document the DON's decision to perform time-critical removal actions at areas throughout HPNS that could contain localized radioactive contamination and substantially eliminate identified exposure pathways to surrounding populations and nearby ecosystems. The DON identified the ARARs for the HPNS removal actions in the AM. The release criteria and remediation goals for HPNS localized radioactive contamination were developed based on the ARARs and were considered to be the most conservative available.

The Parcel C ROD (DON 2010) was prepared to present the selected remedies to remediate soil, groundwater, and radiologically impacted soil structures. The ROD was developed and the remedies selected in accordance with CERCLA as amended by SARA and, to the extent

practicable, the NCP. The CERCLA remedial actions selected in the Parcel C ROD (DON 2010) were necessary to protect the public health, welfare, and the environment from actual or potential releases of contaminants from this site. The ROD addresses radionuclides in soil and structures such as buildings and storm drain and sanitary sewers in addition to other chemical contaminants. The discussions in this RCSR are limited to radionuclide contamination in soil and structures and do not address other chemical contaminants that may be present in Parcel C. The radiological RAO established in the Parcel C ROD was designed to prevent or minimize exposure to ROC in concentrations that exceed remediation goals for all potentially complete exposure pathways. The radiological remediation goals for the Parcel C ROC are presented in this RCSR as Table 2-2.

The present-day configuration of the storm drain and sanitary sewer systems was the result of an evolutionary process that likely caused radiological contamination from the same sources to impact piping and other components of the storm drain and sanitary sewer systems. The CSM (DON 2008) was based on the supposition that radioactive materials likely were discharged from numerous locations throughout HPNS into the storm drain and sanitary sewer systems and may have been released into surrounding soils during the course of normal operations and maintenance or repair activities. The storm drain and sanitary sewer removal actions performed to date support the accuracy of the CSM. Based on historical documentation presented in the HRA (NAVSEA 2004), the ROC selected for the Parcel C storm drain and sanitary sewer systems included Cs-137, Ra-226, and Sr-90. The ROC associated with the radiologically impacted Ship Berths 1, 2, 3, 4, and 5 included Cs-137, Pu-239, Ra-226, and Sr-90.

Chemical contamination at HPNS is addressed through the IR Program process and is consistent with CERCLA as amended by SARA, and the NCP, to the extent practicable. There are a total of eight IR Program sites associated with the Parcel C Phase II project area. Samples of excavated soil derived from IR Program sites were collected and sent to the off-site laboratory for chemical analysis to verify whether the excavated material met the acceptance/reuse criteria in accordance with the approved Parcel C Phase II Execution Plan and SAP (TtEC 2012c). Based on the analytical results, soil that did not meet the appropriate criteria was stockpiled for collection and off-site disposal by the DON non-LLRW contractor, along with non-IR Program soil that exhibited odor or staining.

Fieldwork for the Parcel C Phase II project area removal action was initiated in October 2012 and continued through September 2014. Pre-excavation field activities included installation of temporary fencing, implementation of dust controls and air monitoring, and traffic controls and reroutes. Asphalt and concrete removal was performed in the Project C Phase II project area prior to beginning excavation activities. The majority of the materials removed in the Parcel C Phase II project area were not located within radiologically impacted areas. Consequently, the asphalt and concrete from these areas were transferred to stockpiles pending recycling.

Excavation of the Parcel C Phase II project area storm drain and sanitary sewer systems began on November 19, 2012 in Work Area 35, and the last truckload was excavated on October 10, 2013 in Work Area 31. A total of 288 storm drain and sanitary sewer systems trench segments were identified in the Parcel C Phase II project area during the time-critical removal action. The piping associated with the Parcel C Phase II project area consisted of 2-inch-diameter to 30-inch-diameter CIP, PVC, RCP, steel, UCP, and VCP located at depths ranging from 1 foot to 13 feet bgs. At the completion of the storm drain and sanitary sewer systems removal action activities, a total of 28 trench survey units had been designated in Work Areas 31, 33, 34, and 35. The excavated trench survey unit depths ranged between 1 foot and 14 feet bgs. In total, 11,930 linear feet of storm drain and sanitary sewer systems trenches (inclusive of soil, pipes, and manholes) were excavated during the Parcel C Phase II removal action. At the completion of excavation, the total area of the exposed trench surfaces (sidewalls and bottoms) was 22,067 m².

Soil generated during the excavation of the storm drain and sanitary sewer systems was transferred to RSY3 and RSY4 and spread on screening pads prior to beginning radiological survey activities. During the Parcel C Phase II project area storm drain and sanitary sewer systems removal action, a total of 2,502 truckloads (approximately 30,024 cubic yards) of soil were excavated and transferred to RSY3 or RSY4 for radiological processing. During radiological processing, a total of 3,099 soil samples were collected from the excavated soil survey units. These soil samples were analyzed by gamma spectroscopy in the on-site laboratory including 10 percent for quality assurance verification with 10 percent sent to the off-site laboratory for Sr-90 analysis. Based on the laboratory analytical results, approximately 1,092 cubic yards of soil that exceeded the radiological release criteria was remediated from the excavated soil survey units processed in the RSYs. The remediated soil was placed in LLRW bins for disposal by the DON radiological waste contractor. Radionuclide concentrations greater than the release criteria for excavated soil processed in the RSYs were limited to Ra-226 ranging from 1.486 pCi/g to 2.250 pCi/g. One soil sample collected from the excavated soil survey unit identified as ES-779 showed the presence of Sr-90 above the release criterion at 0.361 pCi/g. None of the Parcel C Phase II project area excavated soil survey units processed in the RSYs identified the presence of Cs-137 contamination.

At the conclusion of the Parcel C Phase II project area removal action, a total of 105 excavated soil survey units had been processed in the RSYs. A total of 45 radiologically processed and released excavated soil survey units were backfilled into appropriate Parcel C Phase II project area trenches. One excavated soil survey unit was placed in LLRW bins for off-site disposal by the DON radiological waste contractor. Soil from a total of 59 radiologically processed and released excavated soil survey units derived from Parcel C project area IR Program sites was transferred off-site by the DON non-LLRW contractor for disposal at a CERCLA landfill.

One radiological device was found during the Parcel C Phase II removal action activities. Device 12-WA35-B204-001 was discovered during a pre-site activity walk through adjacent to Building 204. The device was photographed, logged, and placed in the designated radiological materials area storage locker in Building 258. The device was transferred to the DON radiological waste contractor for off-site disposal on March 28, 2016.

A sufficient volume of sediment for sample collection and analysis was obtained from 21 sections of pipe and 13 manholes during the first phase of the Parcel C project area removal action. These 34 sediment samples were submitted to the laboratory for analysis by gamma spectroscopy. Based on the sediment sample laboratory analytical results, 12 pipe and 6 manhole sediment samples did not identify the presence of radiological contamination above the release criteria. However, the analytical results identified Cs-137 contamination in sediment samples from 5 sections of pipe and 1 manhole and Ra-226 contamination in one section of pipe and three manholes. The highest Cs-137 sediment concentration was identified in a pipe section excavated from trench segment 12-C34-28-8L at 0.3763 pCi/g. The highest Ra-226 sediment concentration was identified in a pipe section excavated from trench segment 12-253-28-8D (TU337) at 5.94 pCi/g. No Sr-90 concentrations above the release criterion were identified in the sediment sample laboratory analytical results. The pipe sections and materials forming the manholes containing Cs-137 or Ra-226 sediment contamination were placed in LLRW bins during the removal action activities. The bins containing the piping debris were shipped off-site by the DON radiological waste contractor as LLRW to either the U.S. Ecology facility in Idaho or the Energy Solutions facility in Clive, Utah.

During the Parcel C project area removal action, radiological survey activities were performed for 398 sections of pipe and 69 manholes. The collected data were reviewed by the RSO to determine whether investigative levels had been exceeded. None of the results identified the presence of radioactivity concentrations exceeding the release criteria.

Small sections of piping were left in place following the completion of the Parcel C Phase II project area removal action due to obstructions such as active utility lines or to protect the structural integrity of stormwater outfalls. In addition, piping was left in place that will be addressed during future Parcel C removal actions and radiological survey activities to be performed for impacted buildings and structures. Radiological survey activities were performed for those sections of pipe permanently remaining in place following the completion of the Parcel C Phase II removal action. None of the radiological surveys performed for the piping permanently remaining in place identified elevated results.

During the Parcel C project area time-critical removal action, a total of 28 trench survey units were designated in Work Areas 31, 33, 34, and 35. Following completion of the excavation and piping removal for each trench, radiological survey activities were performed to determine whether

residual ROC concentrations exceeded the release criteria for the . Gamma scan surveys were performed over the exposed trench surfaces and static measurements were collected from systematic and biased sampling locations, as appropriate. A minimum of 18 systematic soil samples were collected from the exposed sidewalls and bottoms of each of the 28 Parcel C Phase II project area trench survey units designated to determine whether radionuclide contamination was present above the release criteria. In addition, investigative samples were collected and analyzed, as needed, based on the results of trench survey activities and/or piping sediment sample analytical results. Soil samples were submitted to the laboratory for analysis by gamma spectroscopy including 10 percent for quality assurance verification with 10 percent analyzed for Sr-90. A total of 761 soil samples were collected from the sidewalls and bottoms of the 28 designated trench survey units and analyzed by the laboratory. Of these 761 soil samples, a total of 257 were investigative and 504 were the final systematic FSS soil samples. Ra-226 contamination identified in the investigative soil sample analytical results ranged from 2.096 pCi/g in TU313 (Work Area 35) to 2.898 pCi/g in TU316 (Work Area 33). None of the investigative soil samples identified the presence of Cs-137 or Sr-90 concentrations above the radionuclide-specific release criterion.

Soil in the vicinity of trench samples showing the presence of radioactivity concentrations above the release criteria was remediated during the Parcel C Phase II project area removal action. Approximately 163.25 cubic yards of soil was remediated from TU313, TU316, TU318, TU333, TU334, and TU335. The soil sample analytical results for the 22 remaining trench survey units did not identify the presence of ROC concentrations above the release criteria. The contaminated soils remediated from TU313, TU316, TU318, TU333, TU334, and TU335 were placed in LLRW bins pending off-site disposal by the DON radiological waste contractor. The LLRW bins were transported off-site to either the U.S. Ecology facility in Idaho or the Energy Solutions facility in Clive, Utah.

The objective of the storm drain and sanitary sewer systems FSS activities was to demonstrate that identified residual radioactivity levels inside the excavated trench (exposed sidewalls and bottoms) and within the materials used as backfill for each trench met the release criteria. FSSs for every excavated trench survey unit included a 100 percent surface scan and systematic and biased static or direct measurements. Static surface radiation measurements were collected at each systematic sample location prior to the collection of the soil sample to identify the potential presence of gross contamination. A total of 504 systematic trench soil samples were collected and analyzed by the on-site laboratory. The collected data were reviewed by the RSO to determine whether investigative levels had been exceeded. The FSS samples were then submitted to the DoD and ELAP-accredited laboratory for definitive analysis. None of the 504 FSS soil samples indicated the presence of residual radioactivity concentrations above the release criteria.

Dose and risk modeling was performed for each of the 28 trench survey units designated in the Parcel C project area using the default residential farmer scenario of 12 hours per day indoors and 6 hours per day outdoors occupancy as provided in the most current version of RESRAD software at the time of the modeling exercise (Yu et. al. 2001). The results of the modeling efforts for each of the 28 designated trench survey units fell within the acceptable NCP risk management range of 10^{-6} to 10^{-4} , which support radiological free release. Based on the dose and risk modeling results, the highest net dose to workers or members of the public as a result of exposures to residual radioactive materials in soil from the Parcel C Phase II project area trench survey units was identified in TU314 at 4.345 mrem/y with an excess lifetime cancer risk of 7.231×10^{-5} .

The environmental ALARA process was implemented for each of the 28 Parcel C Phase II project area trench survey units. ALARA analyses were performed based on recent estimates of dose to the public from HPNS operations. Based on qualitative ALARA analyses, excavation projects that could cause the potential dose to the public to exceed 1 millirem (individual) or 10 person-rem (collective) were subjected to quantitative ALARA analyses. To date, no operations performed by TtEC at HPNS have resulted in an individual dose to the public greater than 1 millirem or a collective dose greater than 10 person-rem. Qualitative ALARA analyses did not result in any gamma measurements above the investigation levels, and none of the sample results identified ROC concentrations above the release criteria. In addition, air sampling results did not exceed 10 percent of the derived air concentration and the processed personnel dosimetry badges did not identify a single gamma dose above background levels.

The Ship Berths 1, 2, 3, 4, and 5 were identified in Volume II of the HRA (NAVSEA 2004) within the Parcel C Phase II project area. The surveys for the Ship Berths 1, 2, 3, 4, and 5 within the Parcel C Phase II project area were performed in accordance with the task-specific plan prepared for the Ship Berths and the requirements outlined in the Basewide Radiological Management Plan (TtEC 2012a). The objective of the surveys was to demonstrate that residual radioactivity levels in each building or structure met the radionuclide-specific release criterion for the associated ROC, and to achieve radiological release for unrestricted use of the structure. The NRC release limits for unrestricted use were applied in assessing the results of the survey activities. Results were analyzed to determine whether residual radioactivity, distinguishable from background concentration, resulted in a total effective dose equivalent to an average member of the critical (screening) group exceeded 15 mrem/y or the acceptable NCP excess lifetime cancer risk management range of 10^{-6} to 10^{-4} , and if the residual radioactivity had been reduced to levels that were ALARA. This radiological release process ensured that residual radioactivity did not result in individuals being exposed to unacceptable levels of radiation or radioactive materials. The radionuclide-specific release criteria, referred to as DCGLs, used for the Parcel C Phase II project area FSS activities are equivalent to the ROC release criteria presented in the AM (DON 2006) and the remediation goals established in the Parcel C ROD (DON 2010).

Commented [MPL43]: Why was 15mrem/yr used and not 12mrem/yr?

Commented [AS44R43]: The release criteria are based on the Navy AM which for soil is based on NUREG-1757 scaled down to 15 mrem/y.

12 mrem/y for CERCLA sites was established by the EPA in OSWER 9285.6-20 in June 2014. The ROD for Parcel C remediation goals were established in 2010 and the work was completed in October 2013.

Surface concentrations are not based on dose but are from AEC Regulatory Guide 1.86, but doses from these concentrations are very low. For example, AM release criteria is 100 dpm/100 cm² for ²²⁶Ra is equivalent to ~0.17 mrem/y per ANSI N13.12.

Survey procedures were performed in accordance with the SOPs approved for use at HPNS and the Basewide Radiological Management Plan (TtEC 2012a). The Ship Berths 1, 2, 3, 4, and 5 area was divided into 13 Class 1 survey units. Survey Units 1 through 9 were asphalt/soil survey units associated with Ship Berths 2, 3, 4, and 5 and Survey Units 10 through 13 were concrete survey units associated with Ship Berths 1 and 2. Each of the 13 survey units was less than 800 m² in area. No Class 2 survey units were associated with Ship Berths 1, 2, 3, 4, and 5. Each Class 1 survey unit received 100 percent surface scan. Following scanning and data evaluation, alpha, beta, and gamma static measurements were logged at discrete points in each survey unit. Basic statistical quantities were calculated for the data in an effort to identify patterns, relationships, and anomalies. Swipe samples for concrete surfaces were collected at each systematic static location to assess the presence of alpha and beta radioactive contamination that was readily removable from a surface. Gamma scans and static measurements were collected of the asphalt surface prior to removal to access the underlying soil survey units. Asphalt sections were disposed of as LLRW if previously covering soil was found to have ROC concentrations exceeding the release criteria. For the soil survey units, soil samples were collected from discrete systematic static measurement locations, processed, and analyzed by gamma spectroscopy following scanning activities.

Data collected during the survey activities were validated for integrity through verification of numerical results. Following collection of the daily survey data, the results were reviewed by the Radiological Control Technician to verify their completeness, ensure that the data presented were free of numerical or transcription errors, and that established procedures and methodology were followed. The collected data were reviewed by both the area radiological supervisor and the RSO to determine whether investigative levels had been exceeded. In addition, results from the off-site and on-site laboratory analyses were reviewed to ensure that the residual ROC concentrations for FSS samples were less than the release criteria. When a quality issue was identified, the associated soil samples were rejected and new soil samples were collected and analyzed to ensure the integrity and verification of the numerical results.

The dose and risk model for the critical group for unrestricted radiological release for concrete surfaces was based on the default residential (or "Building Occupancy") scenario using the most current version of RESRAD-BUILD software (Yu et. al. 2003). For open area (soil), the most current version of RESRAD software using the default residential farmer scenario was used (Yu et. al. 2001).

The ALARA process was followed for each of the Parcel C Phase II project area Ship Berths 1, 2, 3, 4, and 5. Data analyses were performed for alpha, beta, and gamma radiation to ensure that any possible radioactive contamination was identified. Following the completion of the survey activities, the qualitative radiological impacts from operations in the field were evaluated by performing dose and risk assessments. These results were provided to the ~~RASO-DON~~ and regulatory agencies for review. To date, no operations at HPNS by TtEC have resulted in an

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individual dose to the public greater than 1 millirem or a collective dose greater than 10 person-rem.

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Based on the results of the FSS activities, no residual radioactivity concentrations above the release criteria were associated with Ship Berths 1, 2, 3, 4, and 5. Based on an evaluation of the FSS survey activities and results, the DON concluded that the Parcel C Phase II project area Ship Berths 1, 2, 3, 4, and 5 met the release criteria and recommended radiological release for unrestricted use. Concurrence for the Ship Berths is expected in the near future.

The objective of the Parcel C Phase II project area removal action was to protect the public health and welfare, and the environment from actual or potential releases of radiological contaminants, prevent exposure to residual ROC in concentrations that exceed remediation goals for the ingestion or inhalation exposure pathways, and achieve the radiological release for unrestricted use of Ship Berths 1, 2, 3, 4, and 5 and selected storm drain and sanitary sewer systems trenches. This objective was achieved by meeting the release criteria identified in the AM (DON 2006) and the RAO established in the Parcel C ROD (DON 2010).

The storm drain and sanitary sewer systems within the Parcel C Phase II project area have been removed and no residual radioactivity concentrations above the release criteria remain. As demonstrated by the information presented in each of the SUPRs and summarized in this RCSR, none of the 504 final systematic FSS soil samples collected from the 28 excavated trench survey units or the excavated soil survey units/imported fill used as backfill material identified the presence of residual radioactivity above the release criteria or remediation goals for the ROC.

Additional storm drain and sanitary sewer systems piping in Work Areas 31, 33, 34, and 35 will likely be removed under future contracts; however, selected storm drain and sanitary sewer systems piping in these four Work Areas already has been removed and no residual activity was identified. Regulatory concurrence for Ship Berths 1, 2, 3, 4, and 5 is expected in the near future. The information and data presented in this RCSR, each of the 28 SUPRs, and the FSS report for Ship Berths 1, 2, 3, 4, and 5 confirm the DON's conclusion that the Parcel C Phase II project area removal action resulted in a reduction of the potential risks to levels below the radiological RAO, and no further radiological activities are recommended for the 28 trench survey units and Ship Berths 1, 2, 3, 4, and 5.

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TABLES

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FIGURES

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PHOTOGRAPHS

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APPENDIX A

FINAL SURVEY UNIT PROJECT REPORTS ABSTRACTS:

(on CD only)

**FINAL SURVEY UNIT PROJECT REPORTS ABSTRACT FOR PARCEL
C SANITARY SEWER AND STORM DRAIN REMOVAL CONTAINING
NATURALLY OCCURRING RADIOACTIVE MATERIAL (NORM) FILL
MATERIAL CONDUCTED AFTER MARCH 1, 2013**

**FINAL SURVEY UNIT PROJECT REPORTS ABSTRACT FOR PARCEL
C SANITARY SEWER AND STORM DRAIN REMOVAL AFTER
SEPTEMBER 1, 2012**

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APPENDIX B

**HUNTERS POINT SHIPYARD PROJECT BACKFILL REVIEW AND
ACCEPTANCE PROCEDURE**

(on CD only)

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APPENDIX C
WORK AREA 31 SURVEY UNIT PROJECT REPORTS
(TRENCH SURVEY UNITS 321, 322, 328, 332, AND 339)
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APPENDIX D
WORK AREA 33 SURVEY UNIT PROJECT RPORT
(TRENCH SURVEY UNITS 315, 316, 317, 318, 319, 320, 329, 330, 331, AND
338)
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APPENDIX E

WORK AREA 34 SURVEY UNIT PROJECT REPORTS

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APPENDIX F
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APPENDIX G
PARCEL C PHASE II SHIP BERTHS 1, 2, 3, 4, AND 5
FINAL STATUS SURVEY REPORT

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APPENDIX H
RADIOLOGICAL MATERIAL TRANSFER DOCUMENTATION
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APPENDIX I

PARCEL C PHASE II PROJECT AREA

SEDIMENT SAMPLE LABORATORY ANALYTICAL RESULTS

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PARCEL C PHASE II PROJECT AREA
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IMPORTED FILL LABORATORY
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PARCEL C PHASE II PROJECT AREA

ARCHAEOLOGICAL MONITORING REPORT

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APPENDIX M

**INSTALLATION RESTORATION PROGRAM SITES CHEMICAL
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REGULATORY AGENCY LETTERS

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PARCEL C PHASE II FIELD ACTIVITIES
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